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Clarke, Sarah; Morris, Wyn; Perdikis, Nicholas

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Economic Impact Assessment of the National Spectrum Centre

Sarah Clarke, Wyn Morris, Nick Perdikis,
Aberystwyth University Business School

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Executive Summary

The radio spectrum is a finite natural resource. Demand for it is increasing dramatically, largely arising from an increase in the number of wireless devices and the growing quantities of data being transmitted over the internet. The radio spectrum is essential for running a modern economy and, therefore, an important part of a nation's soft infrastructure.

The aim of the NSC will be to develop products that use the radio spectrum and to increase the productivity of this finite resource. The NSC will develop a hub of radio spectrum expertise and it will enhance delivery of the UK's Spectrum Strategy which aims to increase the spectrum's economic contribution to £104 billion by 2025. Establishing the NSC in Mid Wales and drawing on local expertise and other locational advantages, it will boost the local, as well as the Welsh and UK economies.

Mid Wales is largely a rural based economy with a low population density and employment growth that lags behind the UK and Welsh average. It has an ageing population, with a significant number of young working age individuals leaving the area to find work. This outflow is partly driven by low wages. Local businesses' growth is hampered by poor mobile and internet coverage. Residents living in sparsely populated rural locations also require access to reliable broadband and internet networks to meet their needs. Both local residents and businesses would gain directly from the work of the NSC.

For employment Mid Wales relies heavily on public administration & defence; agriculture; education and health; accommodation and food services. Self-employment in a number of these sectors accounts for a significant proportion of the employment base. The NSC has the potential to generate economic growth and offer high income employment.

The cluster created by the location of the NSC in Mid Wales will increase and enhance knowledge transfer and expertise amongst companies. In training specialists in the field and providing business access to spectrum development facilities, the NSC will increase business and employment opportunities in the area. The output of the NSC will have a positive impact on the future of the radio spectrum industry and employment both in Wales and the UK.

Key sectors interested in the development of the radio spectrum industry include defence and security, agriculture, manufacturing, food and drink, the health service and mobile data. The adoption of new and innovative spectrum technologies represent a keys opportunity for all these sectors to develop their national and international competitiveness.

The proposed site for the National Spectrum Centre in rural Mid Wales offers a unique and ideal geographical location for testing radio spectrum products. Facilities provided by Aberystwyth University, the Aberystwyth Innovation and Enterprise Centre and QinetiQ for radio spectrum research, development and testing will build on this. The NSC will own and have access to test and experiment facilities across Wales. For example, QinetiQ's facilities in Aberporth, with their access to segregated airspace; access to Air, Sea and Land; radar experimentation; UAS expertise and testing facilities.

The establishment of the NSC in Mid Wales has backing from Ceredigion County Council and the Welsh Government. A letter of support has been received from UK MoD and interest in the NSC has been shown by the Home Office. The NSC has been prioritised by the Growing Mid Wales Partnership (Mid Wales Growth Deal) and other key funding bodies, due to its potential for transformational impact in Mid Wales.

The NSC will generate positive economic impacts across Mid Wales in terms of job creation, increased wages and capital investment as well as new business creations. The operation of the NSC will also impact positively on local businesses as well as the tourism and the food and drink sectors. The work predicts that the operation of the NSC could support between 42 and 66.5 jobs in the local area.

1. Introduction

Aberystwyth University Business School was commissioned to undertake an Economic Impact Assessment of the establishment of a National Spectrum Centre (NSC) and its economic impact on Mid Wales and the wider economy. This report contains an overview of the National Spectrum Centre and the importance of radio spectrum to the Welsh economy, an economic overview of the local area and the estimated economic impact that the Centre will bring to Mid Wales. The majority of the work within this report was conducted prior to the Covid-19 lockdown.

> "The National Spectrum Centre aims to create an ecosystem between Government, Industry and Academia in order to accelerate spectrum innovations through experimentation to drive sustainable growth, by providing access to key skills, expertise and facilities"

1.1 National Spectrum Centre Vision

The National Spectrum Centre (NSC) will be a global leader in sponsoring and undertaking spectral research. It will be the UK's centre of excellence for spectrum research and training, with world-class facilities able to attract global players[1]. As part of the National Spectrum Centre Phase 1 development plan, the University has conducted an economic impact assessment (EIA) in order to realise the potential of the NSC and to illustrate the potential economic impact that the centre could bring to the Welsh economy, as a whole and the economy of rural Mid Wales in particular.

1.2 Background

Spectrum dependent systems are part of the national infrastructure. Currently radio spectrum oversight is split between Ofcom and the UK Government. Evidence suggests there is a gap in available radio spectrum provision at a time when there is a rapidly growing demand for new applications. These include autonomous land, sea and air vehicles, intelligent farming, the internet of Things (IoT) and 5G. To meet this increase in demand, the UK Government has set a target to release over 750MHz of public spectrum into the wider marketplace, through auctions and improved sharing mechanisms. All spectrum users will face a need to use the finite spectrum more efficiently. The UK government has also estimated a steep rise in the economic value of spectrum usage[2].

Mid Wales needs high quality jobs to rebalance its economy and ensure a young working age demographic to determine that its economy does not continue to fall behind other parts of Wales. The National Spectrum Centre has been prioritised by the Growing Mid Wales Partnership (GMWP) and other regional funding opportunities, due to its potential and transformational impact on the local economy. The Well-Being of Future Generations

(Wales) Act[3] aims to take action to avoid economic decline and marginalisation and to contribute to the social, economic, environmental and the cultural well-being of Wales. The economic impact of the National Spectrum Centre would lead to positive results in these areas.

The proposed National Spectrum Centre will provide a unique opportunity to address these challenges. It will provide a focus in the development of spectrum innovations and by developing new products and services. This will in turn result in significant, high value jobs, whilst promoting Mid Wales nationally and globally at the heart of spectrum innovation, research, experimentation and development. The Centre will create an ecosystem between Government, Industry and Academia. This will identify, develop and demonstrate the enabling technologies necessary to secure, broaden and maximise the value gained by accessing the electromagnetic spectrum[2].

1.3 Why is spectrum so important?

Radio spectrum refers to a specific range of frequencies of electromagnetic energy used to communicate information[4]. Allocations of the radio frequency are important for things such as radio and TV broadcasting, civil aviation, defence and the emergency services. These are often regarded as vital to the functioning of modern society. Consequently the Radio Spectrum is an important part of a nation's soft infrastructure. It directly contributes, therefore, to its social and economic development by providing spectrum dependent systems for applications such as wireless technology including mobile devices, radar, satellite communication, telemetry, sensors, broadcasting and navigation, defence and security, utilities, businesses networks and 5G[1, 5].

Recently the demands for the radio spectrum have increased dramatically, driven by growing quantities of data transmitted over the internet and rapidly increasing numbers of wireless devices such as Smartphones, tablets and Wi-Fi networks, all requiring access to the spectrum. Radio spectrum is a finite natural resource that needs to be managed to realise the maximum economic and social benefits and is pivotal in maintaining competitiveness in the global arena[4]. The UK Spectrum Strategy has set out goals for the future of spectrum in the UK, including doubling the contribution made by spectrum to the UK economy by 2025[5],[6]. The UK economic contribution of spectra in 2006 was valued at £35 billion and in 2011 was worth £52 billion, an increase in value of 25%. The UK Spectrum Strategy aims to increase this economic contribution to £104 billion by 2025[6].

The radio spectrum is a limited resource and the UK government has agreed that 750MHz of spectrum will be released by 2020. This will be made available for innovations such as spectrum engineering (radar, robotics, sensors, photonics, autonomous cars); rural economy (smart farming-precision agriculture), communication/5G, space technology, MoD and smart cities[6]. To accelerate the spectrum research and development, QinetiQ and the University of Aberystwyth, with Welsh Government support, have proposed to develop a UK National Spectrum Centre in Mid Wales. This will create a collaborative working environment bringing together academia, government and industry[1].

1.4 Economic overview of Mid Wales

In order to put into context, the economic impact that the NSC could bring to the region, it is important to give an overview of the Mid Wales economy, where the NSC will be based. This section will give an overview of population data, economic activity, employment demographics and key sectors that would benefit from the NSC being located in the region.

1.4.1 Local Area

The proposed National Spectrum Centre (NSC) headquarters will be located on the Gogerddan Campus(Figure 1.1) Aberystwyth University, which is located in Mid Wales and in close proximity to the AIEC campus. The Mid Wales region(Figure1.1) is made up of the counties of Powys and Ceredigion, as well as including the Meirionnydd area of Gwynedd to the North and part of the Brecon Beacons National Park to the south, accounting for 39% of the total land mass of Wales[7].

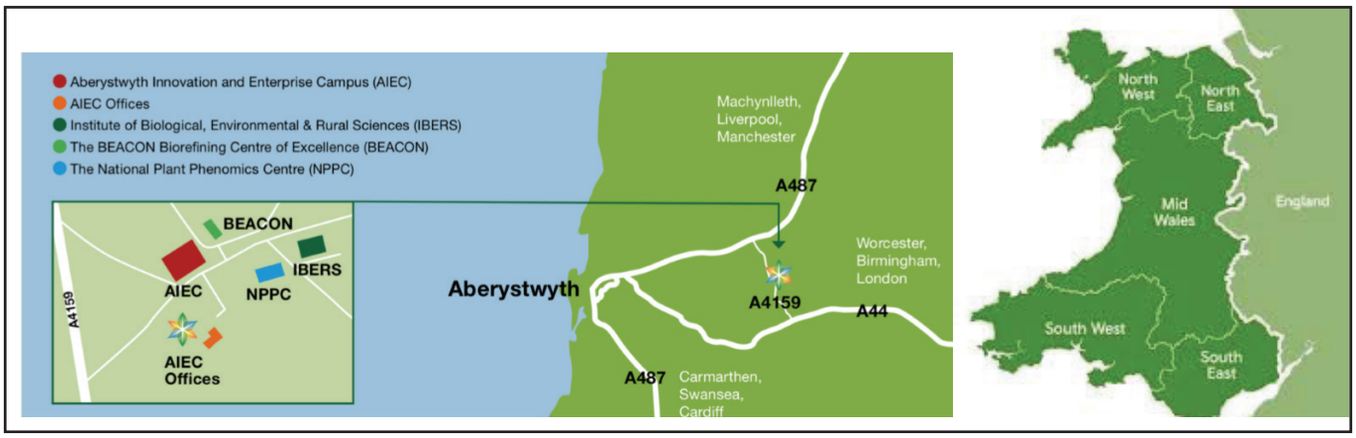


Figure 1.1: ImageA: Location of the proposed NSC headquarters on Gogerddan campus, in close proximity to the AIEC campus (left) and map showing the Mid Wales economic region (right).

1.4.2 Population data

The estimated population for Mid Wales in 2016 was 206.000 people[8], accounting for approximately 7% of the Welsh population (3.1 million). Population densities in Powys and Ceredigion are low (25.5 & 41.3 people/km2) when compared to the national average (150.1 people/km^2). Since 2001 the Mid Wales region has seen a population growth of 2.1%, which is low when compared to the national average, where an increase in the overall population of Wales has seen an increase of approximately 7% during the same period[7,9]. Population projections suggest that the UK population is expected to grow by around 15%, compared with 5% growth across Wales, while the Mid Wales population is projected to decline by 1.7% by 2039. Mid Wales is predominantly rural in nature, sparsely populated, with a few regional employment centres such as Aberystwyth in Ceredigion and Newtown and Welshpool in Powys[8]. The key assets of the Mid Wales region, include its diverse rural landscapes, coastline and rich cultural and historical heritage, supporting a strong tourist industry.

Mid Wales is home to an ageing population with the 45-64 and 65+ age groups dominating the population profiles and the region has seen significant increases in the population numbers aged 65+, with an increase of 25.2% compared with 20.4% across Wales. Across the region a decrease in the 0-15 and 30-44 age groups has also been registered. A fall in the 30-44 age group has been seen of 26% and 30% across Powys and Ceredigion respectively, which represents a worrying decline in the experienced working age population of the area[7].

Mid Wales has a total working age population (16-65) of 114,000 people, accounting for 54% of the population in Powys and 57.8% of the population in Ceredigion in 2016, slightly lower proportions than the UK (62%) and Wales (60.6%) average. The proportion of the population of working age in Mid Wales has fallen in Ceredigion by 8.2% and in Powys by 4.8% over the past ten years compared to a 1.1% increase seen in Wales and a 4.7% increase in the UK[7].

The proportion of the population that are of working age is forecast to fall significantly in Powys between 2014 and 2039 (-25.1%), while Ceredigion is expected to register a slight rise (0.7%) over the same period[7]. A fall in the numbers of the working age population could have a negative impact on the employment base of the area when ageing workers retire and there are insufficient numbers of working age groups to fill positions[7]. A higher dependency ratio puts strains on the economy of an area, as a greater proportion of the population is economically reliant on a smaller working population.

Significant changes in the population structure of Mid-Wales have been seen since 2001. Currently the region is experiencing a significant outflow of residents in their twenties and thirties, and an inflow to Mid Wales of older age groups (aged 40-64)[1]. Improving the employment base in the area could have considerable effect on these patterns, helping Mid Wales to move closer in line with the national average and create a strong employment base on which a successful and diverse economy can be built. Enhanced employment opportunities for the young could reduce or slow down the outward migration of the younger working age group and improve the demography of the region.

1.4.3 Gross Value Added

Gross Value Added (GVA) per capita is a primary indicator of the region's economic performance. Mid Wales maintained a constant output in terms of percentage of national GVA between 1997 and 2015, with Powys accounting for around 4% of national output and Ceredigion 2%. The combined productive output in Mid Wales in 2015 was approximately £3.5billion with Powys (£2.25bn) contributing more than Ceredigion (£1.26bn) to this total[7]. The Welsh economy has lagged behind the UK in its share of high-tech industries and as a consequence has relatively low economic growth rates, unemployment and low productivity as well as unemployability due to lack of skills and qualifications.

Gross Value Added (GVA) for Wales was £17,216 compared to approximately £26,000 for the UK and it is clear that the UK average is vastly outperforming Wales. Mid Wales GVA is even lower than the Welsh average, Ceredigion's GVA in 2015 was £16,849 with wages 12.2% below the Welsh average and 19.6% below the UK average. The difference between the UK average GVA per head and Mid Wales in 2015 was £8,968[10].

Productivity in Mid Wales as measured by the GVA per worker is lower than the national average in several sectors such as manufacturing, financial services, public administration and other services[10]. There are however some employment areas where GVA per worker is significantly higher than average. Powys and Ceredigion display strengths in a number of industries, for example GVA per worker in construction in Powys (£84,000) is 31.2% higher than the national average. While accounting for a small number of employees (230), GVA per worker in information and communication in Ceredigion (£104,348) is 33.4% higher than the average across Wales. Mid Wales also displays strength in the production industries, business services and distribution relative to the national average.

1.4.4 Economic activity

Economic activity rates for Mid Wales are in line with the national average, though rates differ across Mid Wales. Powys has an economic activity rate of 82.0%, which is markedly higher than the average rates in Wales (76.0%) and Great Britain (78.4%) and is the highest across all other Local Authorities in Wales. This is driven by high levels of self-employment in Powys. However, Ceredigion's economic activity rate (69.7%), falls well below the Welsh and British averages. Low levels of economic activity rate in Ceredigion are driven by the large student population, 52.6% of economically inactive 16-64 year olds in Ceredigion are 'students'. This compares to 27.1% in Wales and the United Kingdom and 19.4% in Powys[7].

A fifth of Powys's economically inactive residents aged 16-64 are classified as retired (22.4%), much higher than the proportion of the 16-64 population classified as retired in Wales and the UK (14.3% and 13.1% respectively), whilst a fifth the Powys's economically-inactive residents aged 16-64 are inactive due to them looking after family members or the home, slightly above the Wales average (19.3%), but significantly above the proportion in Ceredigion (6.4%)[7]. These figures represent high proportions of the working age population in the region being economically inactive, resulting in a resident population which has a high 'dependency ratio'.

Unemployment (claims for Job seeker's allowance) are relatively low in Mid Wales, compared with issues such as underemployment, low incomes, low productivity (in some sectors), seasonal employment, high dependency on public sector employment, as well as the outward migration of young from the region. Additionally the uncertain impact of Brexit and potential loss of EU markets on key economic sectors such as agriculture and

manufacturing, as well as further cuts to public sector budgets are also causes for concern for future economic activity in Mid Wales.

1.4.5 Employment growth

Since 2010 both Powys and Ceredigion have shown employment growth that lags behind the Welsh average. Levels of self-employment are significant within the Mid Wales economy. The Mid Wales business base contains almost 13,000 businesses, with the proportion of micro businesses in the region being much higher when compared to the Welsh average. Comparing Mid Wales to Wales as a whole, employment concentrations are apparent particularly in education, public services and accommodation and food services[7]. Since 2010 employment growth has been driven by the accommodation & food services, public administration & the defence industries.

There is huge potential for employment growth in Mid Wales, for instance through the adoption of new technologies and investment to increase the productivity of the region's existing traditional industries such as agriculture and tourism. Building on the academic strengths and expertise of the region would also increase productivity, whilst attracting new industries and a new workforce to diversify the industrial base of Mid Wales[7].

1.4.6 Workforce qualifications and training

Mid Wales performs well in terms of the qualification levels of the residing population. Both Powys and Ceredigion record above average proportions of their populations attaining Level 2 and 3 qualifications. Powys performs particularly well in terms of the percentage of its population with Level 4+ qualifications over 40%, which is higher than the Welsh average of 37.4%. Ceredigion, however, falls slightly below the national average for attainment at Level 4 and above (34.4%)[7]. The larger manufacturing sector in Powys, may be the reason for a higher number of skilled workers in the area, with advanced manufacturing requiring training and qualifications.

The UK Employer Skills Survey[11] provides data on the skills and training by employers and the skills challenges facing industry. It is notable that opportunities for training once in employment in Mid Wales fall below the national average. A total of 46% of employers in Mid Wales offered no training at all during 2016/17, compared to 37% across Wales[7]. Figures published by the Welsh Government[12] showed that there were 2,320 unique learners undertaking apprenticeships in Mid Wales during 2016/17. The largest proportion of these apprenticeships undertaken by Mid Wales residents were at Level 3, compared to Higher Apprenticeships which were more prevalent in Wales as a whole[11].

To achieve high growth and employment rates, a country's businesses need to be at the forefront of research and innovative development. To achieve this, businesses require highly trained and highly skilled employees. The establishment of the National Spectrum Centre with its consequent input into the spectral industries, will be a catalyst for growth and development and have a positive impact on the Welsh economy. The NSC will provide potential opportunities for technical posts, as well as specialist training in "Radio Spectrum Engineering Training" for staff employed in the growing number of companies working in spectrum industry[1].

Evidence also suggests that the private sector working in partnerships with universities can lead to significant benefits to the local and wider economy, recruiting and retaining highly skilled individuals, as well as training local workers. Knowledge transfer, access to training and the development of inter firm linkages via research partnerships and networks are known to be major factor in increasing innovative development outputs. These together promote and enhance an economy's competitive advantage both locally and nationally[1].

1.4.7 Wages

Average earnings in Mid Wales fall below the national and UK average, but have registered growth over the past 5 years, particularly in Powys. Average annual earnings[13] for residents in Powys are £24,884 (£472.20 per week), 5.5% lower than the Welsh average (£26,327) and 13.5% lower than the UK average (£28,758). In Ceredigion, average annual

earnings are £23,118 (£470.70 per week), 12.2% below the Welsh average and 19.6% below the UK average. Wages have increased in both Powys and Ceredigion over the last five years, with Powys seeing a 13.7% increase in average annual earnings since 2013, whereas Ceredigion has registered just a 1.3% increase[13].

The reasons for this difference in wage growth are likely to be wide ranging and complex. This could include the presence of comparatively higher value manufacturing sectors in Powys. Growth could also be associated with Powys being closer to UK markets creating more buoyant labour market conditions and hence driving up wages[7]. The development of the NSC would bring higher quality and higher income jobs to Ceredigion, which in turn via multiplier effects would generate further incomes and jobs within the local economy. This would lead to a significant improvement in the local economy and provide a positive boost to economic regeneration and long-term growth to the area.

1.4.8 Commute to work

Journey times in Mid Wales, both within the region and to surrounding regions, are slow, mainly due to the rural nature of the region. Travel infrastructure around the Mid Wales is made up of A and B roads and rail routes. The Cambrian Line runs from Aberystwyth to Shrewsbury, the closest large English town to Mid Wales and Transport for Wales operates, on average, sixteen direct trains daily in each direction. These provide connecting services to London, Birmingham and Manchester.

The Travel to Work Areas (TTWAs) in Ceredigion are split between two TTWAs. The majority of the county falls in the Aberystwyth TTWA, indicating that many residents of Ceredigion travel to work in Aberystwyth. This is the largest centre of economic activity in Ceredigion and includes major employers such as Aberystwyth University, Bronglais Hospital, Ceredigion County Council and Welsh Government[14]. Powys is made up of six TTWAs; three are wholly in the county, and the other three are predominately located outside of the Powys area, but overlap the county border. Due to the size of Powys, workers' commuting patterns vary, depending on their location within the County. The Newtown and Welshpool TTWA occupies the majority of the North of Powys and employment centres on the two large towns that give the area its name.

Some residents of Mid Wales commute to other areas of Wales and the UK, whilst workers also travel into Mid Wales for work. Ceredigion sees a daily inflow and outflow of 4,118 and 4,135 workers respectively. They commute predominately to and from locations in Carmarthenshire and Pembrokeshire, creating a small net outflow of workers from Ceredigion (-17 workers)[14]. Powys registers a daily inflow of 8,143 workers into the County, with 11,638 commuting to outside the County. This results in a net outflow of 3,495 workers, principally driven by out-commuting across the border to Shropshire and Herefordshire.

This results in a total net outflow for Mid Wales of 3,512 workers, predominantly from Powys. The largest outflow of workers from Mid Wales is to Shropshire (3,164 out commuters), demonstrating strong economic links across the English and Welsh border. Conversely the greatest inflow is from Carmarthenshire, with 1,915 workers coming to work in Mid Wales. A net flow of workers within Mid Wales is seen between Powys and Ceredigion. A total of 392 Powys residents travel to work in Ceredigion, and 258 Ceredigion citizens travel to Powys[7].

1.4.9 Employment demographics

Over the 2010-2016 period employment in Mid Wales has risen, seeing a growth of 7.3%. This has mainly been driven by the accommodation & food services industry, public administration and defence. Only 60.5% of employees in Mid Wales however are full time, compared with 64.8% in Wales and 67.8% in Great Britain. Across Mid Wales public administration, defence, education and health together account for 36.0% of total employment compared with 32.7% in Wales and 26.4% across the UK7. Other notable sectors generating employment include accommodation and food services (12.2%) and retail (10.6%), providing essential services to the region's residents, as well as for an increasing number of tourists visiting the area. Self-employment in a number of these industries also accounts for a significant proportion of the employment base.

In 2017 higher than average rates of self-employment were recorded in the economically active population in Ceredigion (13.7%) and in Powys (19.8%), compared to Wales (9.6%) and the UK (10.6%). This in part reflects the strong entrepreneurial culture within the region, though evidence suggests a certain amount of self-employment is driven by high reliance on seasonal tourist based and agri-based industries, as well as being due to the limited number of opportunities for employment in the region[15].

Since 2010, changes have been seen in the business base across Mid Wales, with a reduction in the number of retail enterprises (-14.7%), a rise in professional, scientific & technical enterprises (+16.6%) and a significant rise in public administration and defence enterprises (+466.7%). Of the businesses located in the Mid Wales region 92.6% are micro-businesses (0-9 employees) and only 0.8% of businesses across Mid Wales are medium or large-sized (i.e. having 50+ employees), compared with 1.6% in Wales and 1.9% across the UK[16].

Significant numbers of micro-businesses in the region are evident in the agriculture, forestry and fishing industry (36.7%), construction industry (10.0%), accommodation and food services (7.0%) and professional, technical and scientific industries (6.9%). Public administration, defence and business administration and support services sectors also have significant numbers of micro businesses. Medium sized enterprises are seen predominantly in the health and manufacturing sectors, representing 6.2% and 4.9% of the total business stock respectively, with health, accommodation and food services, mining, quarrying and utilities, registering a relatively large proportion of small companies in the region (10-49 employees)[16].

Small businesses are the backbone of the UK economy and contribute a great deal in terms of job creation, with micro businesses making up the majority of businesses in the local Mid Wales area. They are an important 'seedbed' for new innovations and play a critical role in driving economic growth. In total, the gross value of these small companies in the UK stands at (£375.73 billion), representing 49.8% of the UK economy.

Small and micro-businesses help to make the UK more competitive and attractive to visitors and investors. They add diversity and variety to towns and cities, while playing an important role in serving the communities in which they are based. Not only do they add more value to regional areas, they also help to boost competition in local markets. By allowing SMEs to develop to their full potential, they could inject a possible £20 billion into the UK economy by 2020, according to the CBI[17].

> "Trading online gives us the opportunity to reach millions of customers around the world and it's this access to a global customer base that will help fuel the growth of hundreds of SMEs in Wales and thousands of small business across the UK."

1.5 Key Sectors

There are a number of key employment sectors in the Mid Wales region, but this section will focus on the sectors which would benefit from the NSC and more specifically with regards to radio spectrum research and development. The NSC has the potential to generate economic growth, with future research and business development opportunities. Within this section potential interest and key sectors or spectrum users have been identified, but are not exclusive and include the following key commercial and research opportunities:

- Defence and security (cyber resilience and security, testing, acceptance and innovation)

- Agricultural-technology
- Infrastructure – improving communications and connectivity to local communities in rural areas, and to smart/future cities
- Intelligent transport systems (road, rail, air) asset monitoring, vehicle tracking, real-time sensing, logging and communications, power transfer vehicle, efficient traffic flow
- UK Space- new applications and testing, space port
- 5G-rural applications and resilience testing
- UAV applications-monitoring and delivery-drones aerospace
- Emergency services and telehealth
- Food security and food transport

There are two Universities in Mid Wales including Aberystwyth University, where the NSC will be based. Interdisciplinary links will be forged between academic departments at Aberystwyth University (Physics, Business, IBERS, Geography, Computer Science), and QinetiQ, alongside local businesses and the Aberystwyth Innovation and Enterprise Centre (AIEC). This will create a cluster for economic development in the area, to explore and develop the potential for innovative opportunities and new radio spectrum enterprises. Further clustering opportunities exist by developing links with the Snowdonia Spaceport at Llanbedr.

1.5.1 Defence and security, space and drones

Wales is a cornerstone of the UK defence operations, with its skilled workforce located in the region and the availability in Mid Wales of secure sites and segregated airspace, enabling full scale testing, training, flight trials and demonstrations, making this an ideal location for defence operations. The airspace spans over 1.500km^2 of land and a further 7,100km^2 over the sea and off the coast of West Wales, which is used to test Remotely Piloted Aircraft Systems[18].

Productivity in the defence sector, has grown by 23% since 2010 and offers the opportunity to deliver highly skilled jobs to the area. The area is home to advanced manufacturing activity in defence and security and generates significant employment. Defence and security is a key sector in the Mid Wales economy and currently employs 300 people in Powys, double the UK averages, and key employers such as QinetiQ employ 150 staff locally.

There is a need within the defence industry to focus on investing in developing new business opportunities, R & D and design and engineering in order to remain competitive in the global market. Around 100 companies in Wales are involved in creating defence applications including software and imaging. One of the key challenges in the industry however, is the lack of access to skilled employees and the lack of access to R & D or design and engineering skills, which are required to drive innovation in this area forward. The NSC could go some way to closing this gap. Brexit also poses a challenge in advanced manufacturing sectors throughout the UK, with significant concerns about the future of defence research and development following Brexit. The importance of driving forward innovation will be key to maintaining the UK's competitive advantage within the global economy in the defence sector.

1.5.2 Agricultural-technology

Agriculture plays a key role in rural communities such as Mid Wales and is of paramount importance to the Welsh economy, employing 58,300 people and supporting Wales's culture, language and communities[19]. Farmers care for and manage over 80% of the land area of Wales and have a key role in maintaining and enhancing its natural environment and the Welsh landscape. The adoption of new technologies and innovation represents a key opportunity for the agriculture sector to increase productivity, efficiency and resilience. In addition, technology could improve business and environmental performance, drive environmental improvements to water quality and soil management and reduce carbon emissions at farm level across Wales.

The development of the Mid Wales network (Long Range Wide Area Network) will allow low-powered devices to communicate with the internet over a long range, placing Mid Wales and in particular its agricultural sector at the forefront

of emerging technologies[19]. LoRaWAN is a wireless communication that allows Internet of Things (IoT) devices to communicate over large distance with minimal battery usage. It offers significant opportunities to transform the Mid Wales' economy and the farming sector via livestock monitoring, estate management and land management. The expertise available at Aberystwyth University and the proposed Spectrum Centre provides opportunities to exploit Lorawan technology within the region.

Opportunities to develop tools for precision agriculture could pave the way for the future of Welsh farming and farming in general. There is huge potential for the development of products, using the radio spectrum, and linking farm businesses, academia and government together to pursue research in the advances into future farm technology. This could include: robotics, drones, and smart machines for agriculture, low cost sensors and wireless networks, soil moisture and crop monitoring, animal health, precision irrigation, and water saving technologies.

1.5.3 Manufacturing

The Welsh manufacturing industry accounts for 16.8%[20] of the country's total output, the second highest in the UK. It has developed strengths in a number of sub-sectors, including aerospace and defence, automotive technologies, transport and the food and drinks sectors. Manufacturing is identified as a key component to delivering a balanced economy and Mid Wales is already home to an established manufacturing sector, with niche areas of expertise, such as automation and motion engineering.

The rise of automation across the manufacturing sector also offers a particular challenge for Wales, with job losses in the manufacturing sector, due to automation, predicted over the next 10 years. Therefore, opportunities to harness and become leaders in developing manufacturing and integrating new technologies will go some way to improving Wales's position in the manufacturing sector.

The future will bring a number of major changes to the manufacturing sector both domestically and internationally. To meet these challenges manufacturing will have to adopt and adapt to new ways of producing goods and services. This in turn will require manufacturers to research into and develop technologies using sensors, Wi-Fi and cellular links. Growing areas such as Intelligent Transport Systems (ITS) and the Internet-of-things (IoT) can be used for remote monitoring and management in warehouses, automated manufacturing and retail. They can facilitate the exchange of information and increase the efficiency and effectiveness of the production cycle. These supply side measures could if taken up by indigenous companies, have a positive impact on Welsh economic growth.

One of the key challenges facing businesses wanting to adopt the new technologies will be a shortage of technical skills amongst the work force. The National Spectrum Centre will offer opportunities for both training of highly skilled spectrum engineers, in addition to the research and development environment to enhance product development.

1.5.4 Food and drink industry

The food and drinks sector is a key economic sector in Wales and growing trends in the food and drinks industry offer opportunities for growth. There are extensive opportunities for technological innovation and process-related innovation, including research and development in the areas of food transport and security, vehicle tracking, precision farming and automation. Other areas of interest include food production, and the close proximity of the NSC to the AIEC and The Future Foods programme would allow links to be developed between the radio spectrum researchers, SMEs and academics already working in this area.

1.5.5 Health and emergency services

The radio spectrum is an essential element of our national emergency services, as well as being important in the future developments of health care facilities. The emergency services rely on radio technologies and frequency ranges to provide them with essential communication capabilities required by rescue services[5].

Telehealth or "eHealth" uses telecommunications and virtual technology to provide virtual home health care, delivering health care outside of traditional health-care facilities and improving access to health care, particularly for chronic disease treatment and for vulnerable groups. Telehealth can also be used by patients requiring online systems to monitor blood glucose levels for example and using a handheld device to detect blood sugar levels, requiring only the availability of the radio spectrum to use the technology.

Telehealth has the potential to have a positive impact both in economic and social aspects. The further development of this technology could reduce the number of visits to health services, whilst also reducing both transport-related emissions and emissions related to operational requirements. It thus has the ability to reduce costs and demand on health care systems. With the UK currently in lockdown due to COVID 19 and with many patients concerned and avoiding unnecessary visits to GP surgeries and hospitals, the development of remote access to some medical assistance has never been more important. It is likely that there will be growing interest in this arena and the potential of radio spectrum telehealth development[21].

1.5.6 Access to internet, the wireless economy and 5G

The rural nature of Mid Wales, with poor access to services and an increasing reliance on online service provision means that access to efficient broadband or internet connection is essential to local businesses, residents and public services. It is increasingly seen as an essential service, with so many residents living in rural locations and businesses working remotely, all requiring access to reliable broadband. With the current situation regarding the lockdown, due to COVID 19, communications via the internet and mobile data have seen a surge in demand, as people all around the world have tried to stay connected whilst having to remain at home. The importance of reliable connectivity has never been so crucial.

The Economic Development Strategy[22] recognises the importance of improving internet speed and mobile infrastructure to attract new residents and businesses to the area and to encourage the younger generation to remain and work within the region. Rurality and isolation are often compounded by poor ICT infrastructure and efficient broadband is known to drive economic growth. Further competition from the global marketplace, as a result of online services, signifies improvements in decent internet connections are essential for local businesses to remain internationally competitive.

3G mobile coverage in the UK is rated as good, with less than 1.3% of premises having no coverage. Powys and Ceredigion, however, have worse coverage than the UK average, these figures are 8.4% and 7.8% respectively. Across the UK 4G is available in most cities and towns, however in rural areas it is a different story. Sufficient 4G mobile coverage is an issue across the UK with around 29% of businesses having unreliable mobile internet connections, rising to 54% in rural areas. A lack of access to 4G is particularly noticeable in smaller companies, which is a particular challenge in Mid Wales, as 89% of businesses are micro businesses. Currently in Powys 58.6% of the county has no 4G coverage and in Ceredigion the figure is 25%, which is significantly lower than the UK average. The Government has pledged that by 2020 everyone across the UK will have a right to request high speed broadband and the Welsh Government aims to target specific areas in Wales, with Ceredigion and Powys set as priorities[23].

The Welsh Government is working in partnership with the mobile industry, Ofcom and UK Government to improve mobile coverage, encouraging further investment and promoting innovation in mobile technology in Wales. Opportunities to develop and test innovative technologies have been identified, including 5G, the next wireless technology being developed by mobile network operators. 5G is expected to deliver higher bandwidths and higher speeds for high definition streaming, however the public health concerns over 5G developments need to be allayed before developments of 5G are rolled out into communities. The potential for providing information and education material should be within the remit of the NSC.

Developments in the future of mobile connectivity, particularly in rural areas would have a major impact on local businesses, as well as providing improved connectivity for isolated residents and for

essential services provided by the public sector. The NSC will provide the scope and potential for mobile technology research and associated developments, as well as the potential to train current and future engineers in the mobile industry.

1.6 Summary

- The Radio Spectrum is an important part of a nation's soft infrastructure and an essential service.
- It is a finite natural resource and demands have increased dramatically, due to the growing quantities of data transmitted over the internet and the increase in the number of wireless devices.
- The UK Spectrum Strategy aims to increase the economic contribution of spectra to £104 billion by 2025 and there is huge potential for further developing spectrum technology.
- The proposed site for the National Spectrum Centre is in rural Mid Wales-offering specific facilities for radio spectrum research.
- Mid Wales has a rural economy with a low population density. It has an ageing population, with a significant number of the young working age population leaving the area.
- Outflow of young working age people is driven by low wages and poor access to mobile coverage, essential for developing businesses.
- The region relies heavily on public administration & defence; education and health; accommodation and food services for employment. Self-employment in a number of these industries accounts for a significant proportion of the employment base.
- Gross Value Added (GVA) for Wales is below the UK average and the Mid Wales GVA is even lower than the Welsh average, with Mid Wales employment growth lagging behind the Welsh average.
- The NSC has the potential to generate economic growth, placing Mid Wales on the world stage, offering high income jobs and training a highly skilled workforce in the radio spectrum industry.
- Key sectors interested in the radio spectrum industry include defence, agriculture, manufacturing, the food and drinks industry, the health service and mobile data companies. The adoption of new technologies and innovation represents a key opportunity for all these sectors.
- Wales contributes significantly to UK defence operations and provides an ideal location for defence operations via its skilled workforce, availability in Mid Wales to secure sites and segregated airspace.
- The rural nature of Mid Wales, poor access to services and increasing reliance on online service provision mean that access to efficient broadband or internet connection is essential to the development of local businesses and the provision of public services. With so many residents living in rural locations and businesses working remotely, all requiring access to reliable broadband, the reliability of the internet is increasingly becoming an essential service.

2. National Spectrum Centre and Key Stakeholders

In September 2018, a one-day conference was held at Aberystwyth University to showcase the National Spectrum Centre. This was a high profile event with the keynote speech given by Alun Cairns, the then Minister of State for Wales, and with an attendance of over 150 representatives from industry, SMEs and academia from across the globe, reflecting A very successful event the wide interest in the concept of an NSC. The following section gives further details on the NSC and an overview of the key stakeholders that will be involved in its establishment.

2.1 The National Spectrum Centre

At this stage it is proposed that the NSC will operate as a not-for-profit limited company with revenue matching running costs and structured as a joint venture between Aberystwyth University and QinetiQ supported by Ceredigion County Council through the Mid Wales growth Deal[1]. Funding has been secured for the establishment of the first phase of development of the National Spectrum Centre, which will provide a platform to support further funding applications. The Centre has also been prioritised by the Growing Mid Wales Partnership and other regional funding opportunities, due to its potential for transformational impact[2].

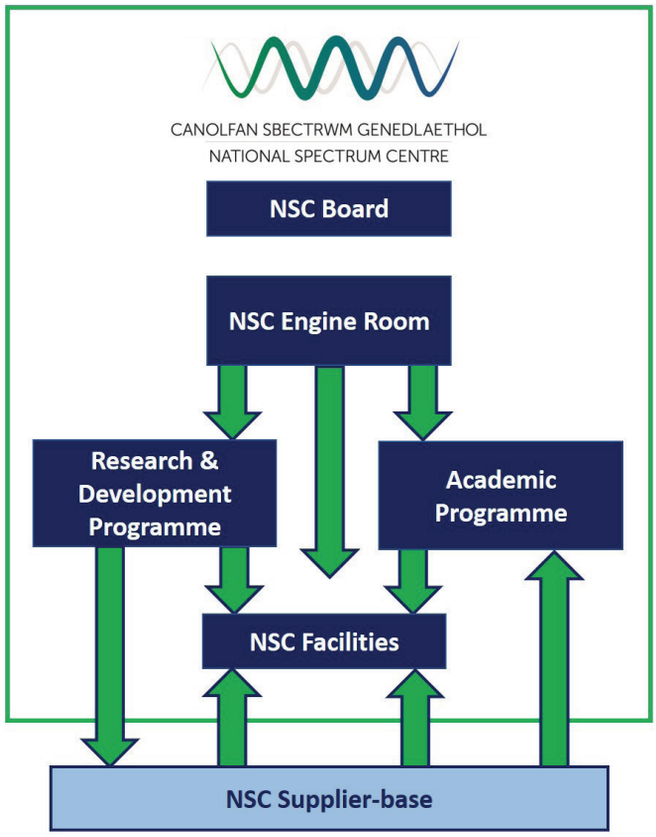
The NSC aims to create an innovation cluster, pooling together expertise and talent operating in the radio spectrum sector, stimulating innovative business activity and sharing of facilities. The cluster aims to increase knowledge transfer and expertise, training new potential specialists in the field and provide access to spectrum development and testing facilities to businesses. This will in turn increase research and development potential and facilitate the rapid advancement of radio spectrum technology as well as increasing employment opportunities in the area.

The NSC plans to operate two programmes: (1) a research and development programme (Figure 2.1) that will manage research projects sponsored by third-parties, and (2) an academic programme composed of PhD and MSc programmes, as well as stand-alone training courses [2]. Alongside the research programmes, the NSC's aim is to help organisations and businesses research, develop and test spectrum-dependent systems more quickly, thoroughly and at lower cost than ever before. The centre will provide easy access to large-scale instrumented spectrum range facilities and user environments, which will allow the testing of services and devices in realistic environments with minimum infrastructure set-up[1].

The proposed NSC organisational structure is shown below:

NSC Board
An executive board with an independent chair and representatives from Aberystwyth University, QinetiQ, and Principal Stakeholders (e.g. CCC, Companies, MoD)

Research & Development Programme
The activities to plan and organise the research programme; both in terms of best athlete process for the NSC research programme and scheduling and managing third-party sponsored research.



NSC Engine Room
The team running the NSC; undertaking such tasks as Welsh Government interaction, NSC programme planning, supply-chain management, HR, communications and event management.

Academic Programme
The activities to plan, organise, run and supervise postgraduate activities, PhDs, MSc and training courses.

NSC Facilities
The research and development facilities available to the R&D and academic programmes. The facilities fall into three categories:
1. NSC owned
2. Third-party owned, NSC instrumented
3. Third-party owned

NSC Supplier-base
The NSC will have an established supplier-base to service the R&D programme. There will be two levels of membership:
1. Full membership. An entry fee will provide members with regular newsletters, early notification of events and research programme.
2. Associated membership. No fee but members have access to the NSC facilities for their own use.

Figure 2.1: NSC organisational structure[1]

2.2 Key Stakeholders

2.2.1 Aberystwyth University

Aberystwyth University is spread over three campuses. Penglais and Llanbadarn campuses are located close to the main town and its Gogerddan campus, which is the location of the Aberystwyth Innovation and Enterprise Campus (AIEC) and the internationally renowned IBERS research centre. The Gogerddan campus will be the location of the NSC headquarters. The University has around 8,500 students across its faculties of Arts, Sciences and Social Sciences and it is known for its world class research. Aberystwyth University has access to a wide range of facilities and expertise. These include expertise in areas such as robotics and autonomous vehicles (Computer Science), future foods and smart farming (IBERS), earth observation and spatial data (DGES), links with local businesses (Business School), laboratories, upland and lowland sites, crops, as well as SMART Farm testing. Aberystwyth's Physics department will play a key role in Spectrum research and the provision of post graduate education and training programmes in Spectrum Engineering. Aberystwyth University has already created a lectureship in this academic area.

According to the Research Excellence Framework 2014, which assesses the quality of research in UK higher education institutions (HEIs), 95% of the research activity submitted by Aberystwyth University was of an internationally recognised standard or higher, with world leading research (4*) identified in all 17 of the Units of Assessment submitted. The University was also named 'University of the Year' for teaching quality in the Times and Sunday Times Good University Guide 2019 and Welsh University of the year 2020. Its world class status will enable it to develop new national and international research collaborations to support the centre.

2.2.2 Aberystwyth Innovation and Enterprise Campus (AIEC)

Around £40.5 million is being invested in the Aberystwyth Innovation and Enterprise Campus (AIEC), which will provide world leading facilities and expertise for the agricultural-technology industry and the bioscience sector. The main NSC headquarters will be located within close proximity to the AIEC campus, which will provide high quality processing spaces and laboratories, scientific equipment and offices. AIEC already hosts potential business partners in the bioprocessing centre; future food centre; analytical science centre for the development of new products and biotechnology. AIEC will provide an ideal environment for business and academic collaboration to flourish and will offer an ideal partner for the NSC and associated industry partners.

2.2.3 QinetiQ

QinetiQ (Aberporth)[17] employs 150 staff locally, all living within a 60 mile radius of QinetiQ. It employs 6000 staff globally, who provide technological and scientific expertise in radio systems, cyber security, spectrum resilience, governance, autonomous systems and 5G testing. QinetiQ has access to segregated airspace; access to Air, Sea and Land; radar experimentation; UAS expertise and testing. The NSC will be able to draw on QinetiQ's wealth of expertise and its position as a trusted industry partner across all industry sectors and will be a key player in collaborative radio spectrum research and innovation developments.

2.2.4 UK and Welsh Government

The Welsh Government recognises that regional inequalities exist within Wales and aims to match, at least, the current investment levels in the post-EU era. Acquiring investment for Mid Wales from the Government should therefore be realistic, providing a feasible regional action plan can be developed. The Welsh Government's strategies propose to strengthen the economic foundations and future-proof the Welsh economy by focusing on regional economic development, delivering a modern and connected infrastructure and supporting people and businesses to drive economic growth[24]. The Well-being of Future Generations (Wales) Act[3] also aims to increase the incidence of and access to opportunities for Mid Wales residents through targeted investments.

The NSC has been prioritised by the Growing Mid Wales Partnership (GMWP)[7] and other regional funding opportunities, due to its potential for transformational impact on the local economy. The Growing Mid Wales (GMWP) Regional Programme of

Interventions aims to increase productivity, diversify the economic base and increase the number of high value jobs in the region. GMWP understands the importance of maintaining investment for regional economic development and key propositions include responsive skills, infrastructure and digital connectivity and bringing Powys and Ceredigion together to lead a collaborative approach to economic development[7].

Correspondence regarding the development of the NSC centre has not only demonstrated significant interest and support from the Growing Mid Wales Partnership but has also had support from Ceredigion Council and Welsh Government in order to apply for the Mid Wales Growth Deal funds.

There has also been a letter of support for its development from UK MoD and interest from the Home Office. Comments in support of the development of the NSC from government figures and MoD:

"Aberystwyth University plays a central role in the local economy, and makes a crucial contribution to the wider Welsh and UK outlook. There is no better demonstration of this university's success than that of an industry leader investing in a project which it believes will be commercial success." Furthermore, "this project will help the university build on its foundations of teaching excellence, training the next generation of radio systems engineers. It will also provide a home for ground breaking research, both for the university's purposes, but also to ensure the UK meets wider industrial or government challenges"

Alun Cairns the then Secretary of State for Wales.

"My team will encourage Governmental and International spectrum users to use the centre and also provide access to defence managed spectrum, free of charge, using a mutually agreeable process. MoD will also contribute by being a member of the management board to provide Defence oversight on the running and aims of the Centre"

Martin Elliot, Director Design MoD letter of support.

2.3 Facilities and site details

The NSC will operate on a hub and spoke basis and its Headquarters will be based at the Milford building (Figure 2.2) on Gogerddan campus from December 2020. This will be the hub of Spectrum Research for the UK and control a range of activities across the UK. Through the NSC will have access to test and experiment facilities across Wales (the spokes). These will include a segregated airspace allowing access to air, sea and land, radar test facilities and a cyber-range, for example using the QinetiQ site in Aberporth. As mentioned above, the NSC will have access to state-of-the-art laboratory facilities on the AIEC campus, as well as having access to a range of facilities at the QinetiQ site in Aberporth, Ceredigion. At this stage, the scope and breadth of these two bases is still under discussion. Other facilities located within Ceredigion could include: an indoor testing range, cyber range, spectrum observatory, covered valley, (locations still to be identified) drone and radar test facilities in Aberporth. (See appendix for more details)

Figure 2.2: Gogerddan campus, site of NSC head quarters

Aberystwyth University is currently funding the refurbishment of the headquarters in order to establish a physical entity for the stakeholders to use. This is seen necessary to support initial projects which industry is eager to support. Further funds will need to be invested in order to meet the full requirements of the NSC, including developing the NSC education facilities, fit for purpose laboratory facilities, as well as an out-door lab environment. The University is already investing in the development of the NSC and planning to raise external funds; examples of which can be seen in the table below (Table 2.1).

Potential Funding Source	Amount	Purpose
Welsh Funding		
Economic Development Fund	£250k - £5m	Facilities and infrastructure
Welsh Training Fund	£250k	Training capability
Mid-Wales Growth Deal	£20m	Education and innovation facilities
Cardiff City Deal	£500k	Facilities and infrastructure
North Wales Growth fund	£550k	Facilities and infrastructure
Total	**£21.5m-£26.25**	

Table 2.1: Potential NSC Funding streams for facilities and infrastructure

2.4 Summary

- The National Spectrum Centre will be a unique hub of radio spectrum expertise, located in Mid Wales and will be a boost to the local, as well as the Welsh and UK economies.
- Widespread and significant interest in the concept of an NSC has already been established.
- The NSC has backing from the Ceredigion Council, the Welsh Government, a letter of support from the UK MoD and interest from the Home Office.
- It has been prioritised by the Growing Mid Wales Partnership (Mid Wales Growth Deal) and other key funding bodies, due to its potential for transformational impact.
- The cluster aims to increase knowledge transfer and expertise, training new potential specialists in the field; providing access to spectrum development facilities to businesses; whilst increasing employment opportunities in the area.
- NSC will be a collaborative research environment embracing Government, Academia and Business driving forward radio spectrum technologies to enhance productivity in relevant sectors.
- The NSC plans to operate two programmes: a research and development programme and an academic programme composed of PhD posts and MSc programmes, as well as stand-alone training courses.
- The NSC will own and have access to test and experiment facilities across Wales, for example via its involvement with QinetiQ in Aberporth, and its access to segregated airspace; access to Air, Sea and Land; radar experimentation; UAS expertise and testing.
- The rural environment in Mid Wales is ideal for testing radio spectrum products and services, with facilities and skills provided by Aberystwyth University and by its trusted partner QinetiQ.

3. The Economic Impact of the National Spectrum Centre

All companies and research institutes generate a set of core economic impacts, including direct and indirect impacts, which in turn cause multiplier effects in the local area. Direct economic impacts are the direct effects the organisation has on the region due to its operations. Multiplier effects are the additional economic impacts, created as a result of the organisation's direct economic impact. The day to day operations of the NSC will have an economic impact, including core impacts such as: capital investment, supplier impact, employing staff, staff spending impacts (as a result of spending money on goods and services in the area), student and visitor impacts. All of these will be discussed below in more detail.

It is estimated that as a direct consequence of establishing the NSC, between 50 and 100 jobs could be created over time. These predominantly high income jobs will be created in an area of Mid Wales not known for this type of employment. The staff employed by the NSC will have a positive impact on the wider economy. Via multiplier effects, these jobs will generate further incomes and jobs within the local economy. Relatively recent studies in Mid Wales have estimated that the multiplier effects range between 1.28 and 1.5[25].

3.1 Methodological approach

Wavehill Social and Economic Research were employed to conduct the economic impact assessment. Data For this element of the economic impact report, included information gathered from the National Spectrum Centre marketing and feasibility study, The National Spectrum Centre Strategy and the Draft Operating Model and Phase 1 development plans.

A literature review of the Mid Wales economic overview and current population data was obtained from ONS data and the Mid Wales Growth Deal (2018) and information was obtained on government strategies from government websites. Information regarding radio spectrum was gathered from a number of sources, including the UK Spectrum Strategy (2014), the Department of Business, Innovation and Skills and the Department for Culture, Media and Sport.

Economic values calculated for the economic impacts as a result of: operational impacts, employee impacts, teaching and learning impacts, student impacts and business impacts were estimated, given the details extrapolated from the documents published by AU on the development of the NSC. These were calculated based on the number of expected employees and students to be generated as a result of developing the NSC. Multiplier effects were added and it is reasonable to assume a relatively high multiplier effect for the local area, and thus a multiplier effect of 1.5 was added, to account for the indirect and induced impact The full scope of the NSC had not been finalised at the time of writing this report and therefore the figures are given as an estimated value given the speculative economic impact of the NSC.

A series of stakeholder engagement events and workshops were held to raise the profile of the NSC, where details of the planned NSC facilities were shared. Details of the attendees (and organisations they were attending on behalf of) who attended these events were shared with Wavehill. Telephone surveys were carried out to establish the likely level of usage of the NSC. It was assumed that those

attending the event were likely to be interested in utilising the NSC. Direct contact details were obtained for those attendees who had consented to sharing these. Where consent had not been secured, publicly available contact details for employers were obtained from their websites and individuals were contacted via that route with consent obtained, prior to the telephone survey commencing. Wavehill sought to engage with attendees of the main event through telephone surveys.

The telephone survey conducted by Wavehill sought to establish the likelihood of the NSC being used and how the attendees envisaged using the centre once established. The research survey tool used for this part of the research can be found in the appendix of this report. A total of 50 contacts were made available to Wavehill as the eligible population to survey. Since attending the event, three contacts had subsequently left the organisation that they had attended on behalf of whilst one contact had an incorrect email and no telephone number could be found. This left 46 eligible contacts for the research, of these 25 completed the survey equating to a healthy response rate of 54%.

3.2 Key Findings

3.2.1 Usage of the NSC

The telephone survey conducted by Wavehill on our behalf, commenced with an exploration of the likely level of usage of the NSC. Over three quarters (80%; 20/25) of respondents reported their company would either likely or definitely use the NSC(Figure 3.1) once it was operational.

Of the five organisations that felt they were unlikely to use the centre, the most common reason related to the NSC's location. Organisations cited that they were able to use testing centres closer to their base. Another reason put forward was that the NSC's testing facilities would not be relevant to their work and so they would not have a need for it. These organisations, however, also mentioned working with businesses (collaboratively or in their supply chain) that might require and would benefit from

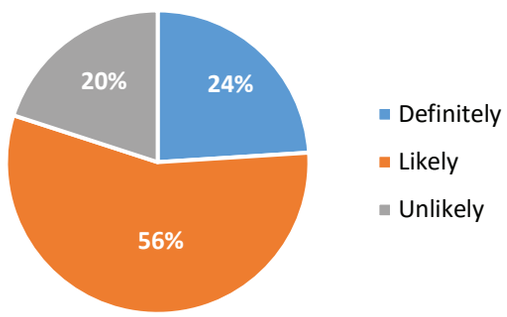


Figure 3.1: When the NSC is fully operational how likely do you feel it would be that your company would use the centre? N=25

NSC type facilities so remained in support of its establishment. In their responses to subsequent questions within the survey these respondents then reflected on the usage of the centre through their supply chain.

When asked in what ways their organisation would use the NSC, it was evident that each organisation saw a range of uses for it. The most common was the testing and evaluation services (across all market sectors) and collaboration on research programmes(Figure 3.2). Access to academic support and research laboratories, early product development and the generation of Intellectual Property were also cited by the majority of respondents.

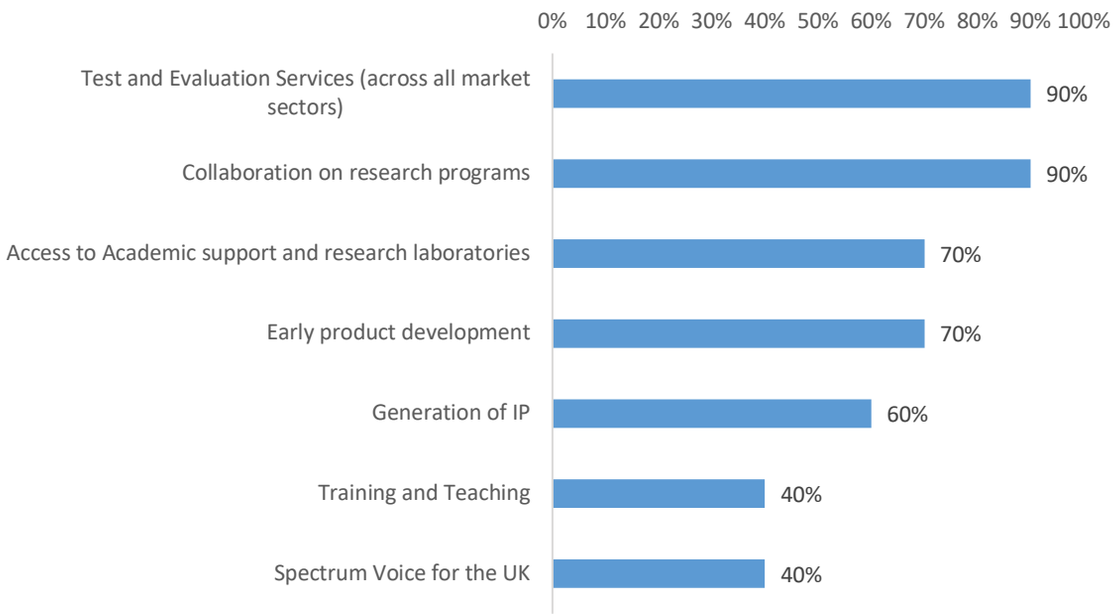


Figure 3.2: For which of the following activities would you envisage using the NSC? N=20

Just over half (55%; 11/20) indicated that cost would affect their decision to use the facility to some extent or a great extent (Figure 3.3). A number indicated that transport cost were a concern with many of them citing concerns relating to travel time and its associated cost to the operation of their business. However, 40% (8/20) of businesses suggested that cost would impact their decision to use the facility minimally.

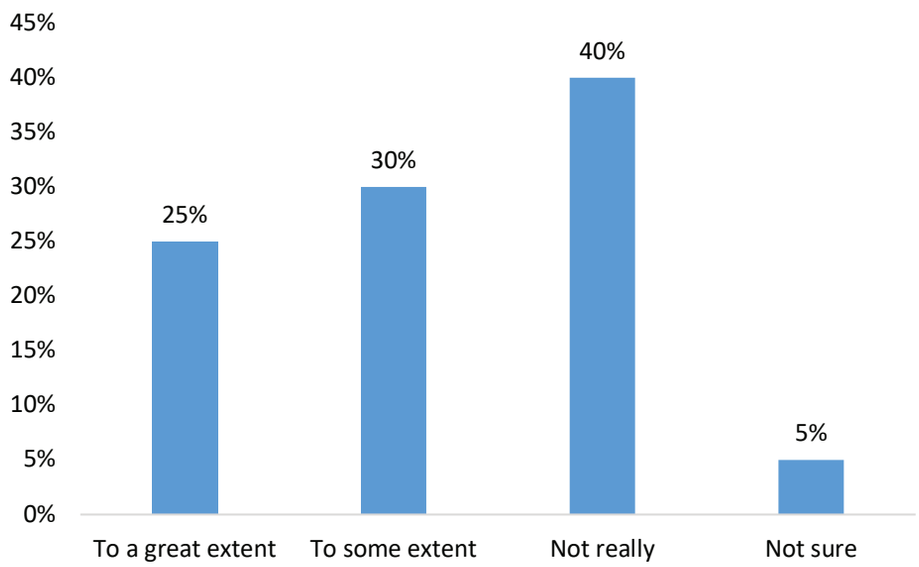


Figure 3.3: To what extent would cost be a factor in guiding your decision as to whether you would use the facility? N=20

Respondent businesses were asked of their interest in joining a membership scheme where the nature of membership would determine the extent of access they would gain to services and facilities at the NSC (Figure 3.4). Around two-thirds (76%; 19/25) of businesses would consider joining a membership scheme with over one-third (36%; 9/25) confirming their interest. Many indicated that it would be a good method of encouraging frequent use and securing funding. Others suggested discounted access or enhanced access would increase their likelihood of becoming a member.

For the remaining 24% (7/25) which would not be likely to join, the main concern was around cost and commitment. These were mainly smaller businesses and were not in a position to afford a large outlay for a long term commitment when their testing stage may only be for a short period. Others, in particular freelance companies suggested they would not have enough use for the centre to warrant membership. Larger companies expressed concerns around a lengthy compliance process that might be required to engage in a membership scheme.

The respondent businesses were asked if they'd be interested in receiving details of potential training packages that would be delivered through the centre. Around three-quarters of all respondents (76%) reported that they would welcome details of such training packages (Figure 3.5).

On average, respondents suggested they would require access to 10 or 11 of the 18 facilities available under the NSC umbrella (Figure 3.6). The most commonly required facilities (all of which at least four out of five respondent organisations would use) were an outdoor lab environment (88%), the spectrum observatory (80%) and drone testing facilities (80%) (Figure 3.6 overleaf).

Fewer than half of the businesses reported requiring a need for road test or rail test facilities (48% and 40% respectively). Anecdotal comments suggested such facilities were already available in their areas whilst less than one-third (28%) perceived a need to secure office space within the NSC.

When asked if any other facilities might be required 14 of the respondents answered positively. Almost half of these (43%) referred to the need for secure test facilities (including secure facilities away from

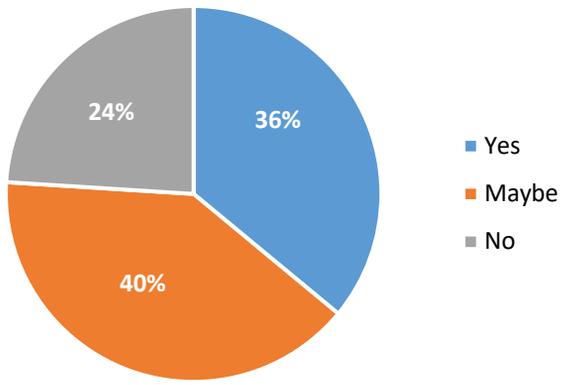


Figure 3.4: Would you be interested in a membership scheme with fees determining the level of access to facilities and services? (Ranging from a full membership with full access to events, research programme and facilities to an associate membership with access to facilities for own use.) N=25

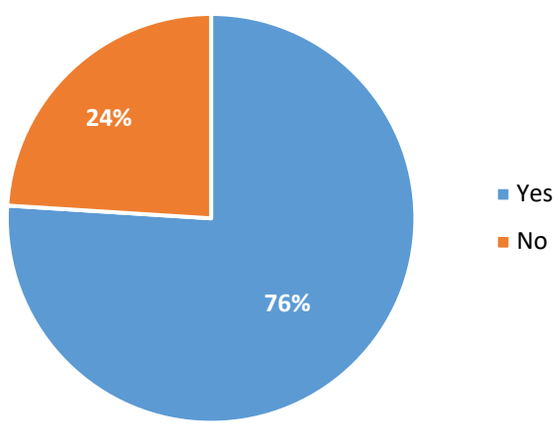


Figure 3.5: We are developing a high-level training package in radio spectrum engineering for businesses which we hope will be subsidised through European funding. Would you welcome details of this training package? N=25

members of the public, security at the facility as well as compliance to government testing guidelines) (Figure 3.7).

Around one-third (29%) indicated that it would be beneficial to be given the opportunity for real world testing of their products. One-fifth (21%) of the respondents suggested remote access such as satellite and video conferencing facilities would be of benefit to them, helping to offset the challenges of the peripheral nature of the location (Figure 3.7 for further details).

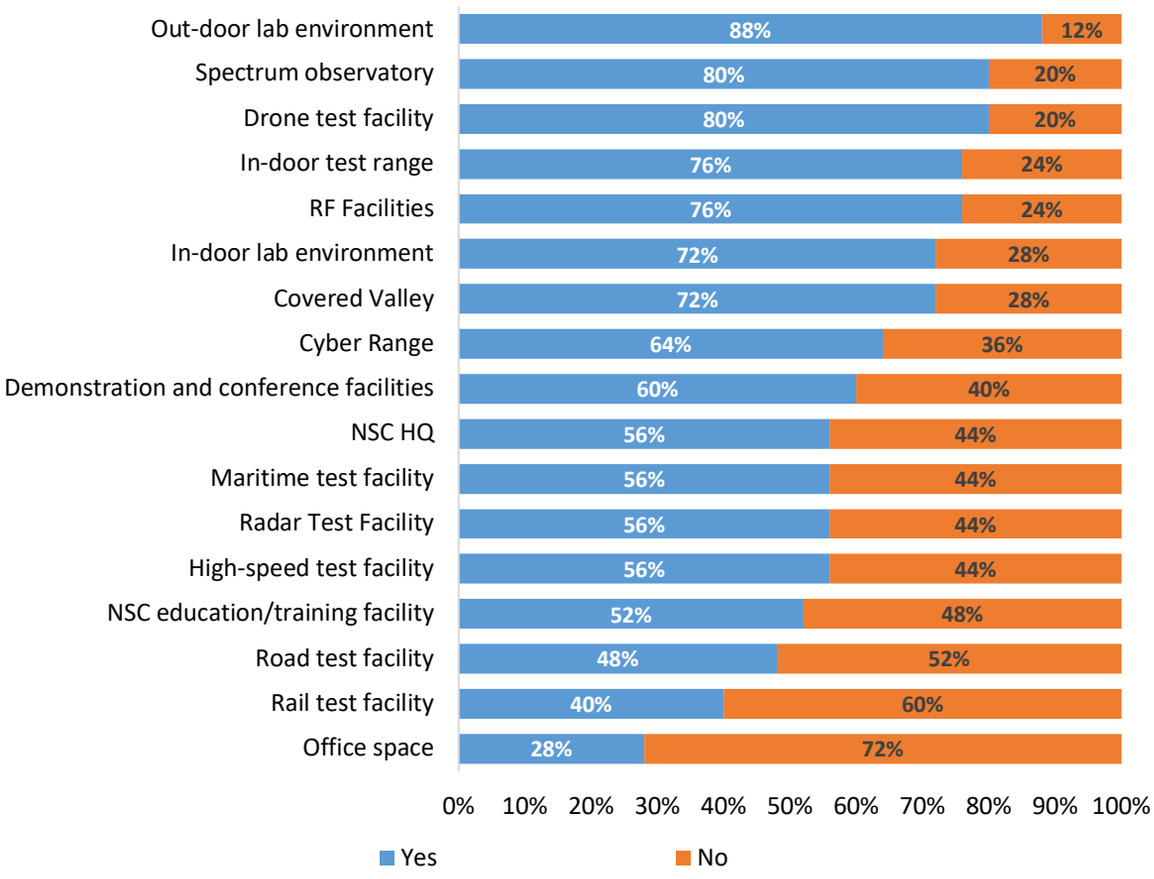


Figure 3.6: One of the strengths of this region is having access to a range of facilities under the NSC umbrella. Would you require access to one or more of the following?

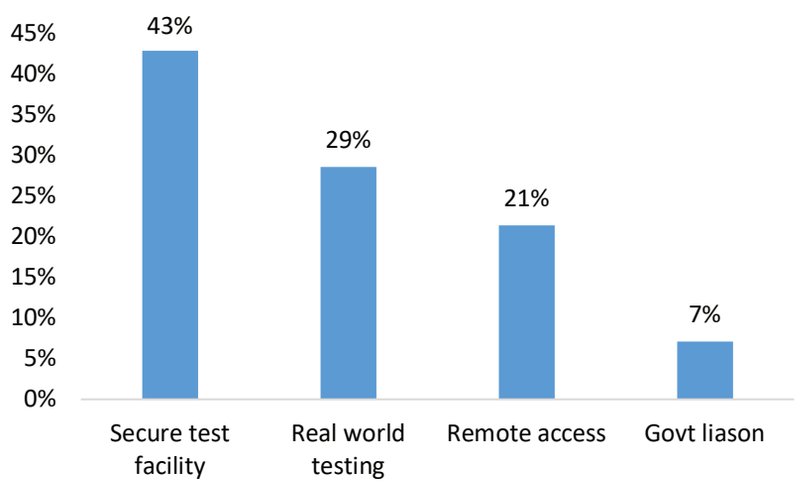


Figure 3.7: Are there any other specific facilities that you would benefit from or prefer? N=14

3.2.2 Estimated scale of use

To help understand the nature of impact derived from the centre's offer, the scale of use of the NSC was explored with respondent businesses. One business indicated it would be likely to set up a local presence in the area once the NSC was operational. Two respondents were already based in the area while the remainder (88%) indicated they would be happy to travel to the centre for occasional use (Figure 3.8).

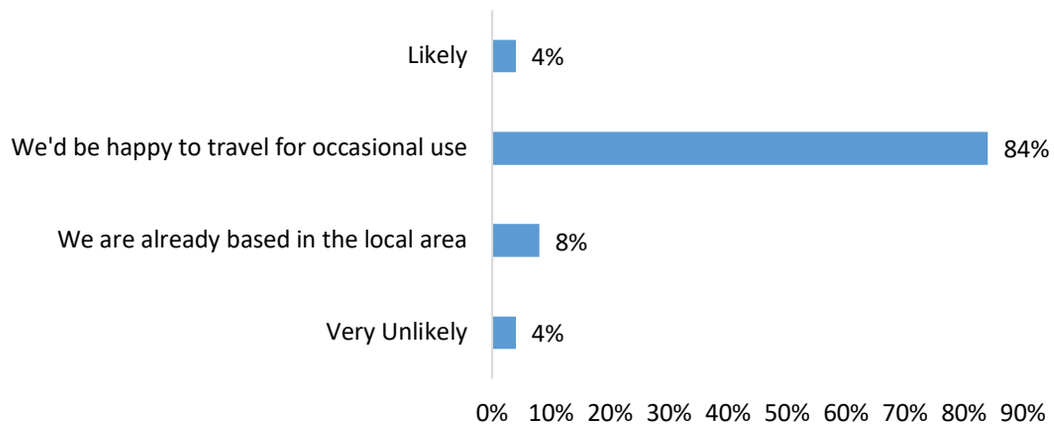


Figure 3.8: When the NSC is operational, how likely is it that you/your organisation would set up a local presence (in either the available offices or other local offices for example) in the area? N=25

Respondent businesses were asked how often they would use the facility and for how long they would use it. In terms of frequency, just over half indicated they would use the facility twice year. In terms of length of use, 43% suggested they would use the facility for a week or so, whilst a further 39% suggested they would use it for a day or two (Table 3.1).

Table 3.1 illustrates the range of usage amongst respondent businesses with one respondent anticipating the use of the facility on a monthly basis for one month at a time whilst the most popular frequency was the use of the NSC twice a year, with each period of usage likely to last for a week or two.

	How often would you use the facility?			
If you used the facility how long would you be there?	**Monthly**	**Quarterly**	**Twice a year**	**Once a year**
A couple of months	0	0	0	1
A month	1	0	2	0
A week or two	2	1	6	1
A day or two	0	2	5	2
Total	**3**	**3**	**13**	**4**

Table 3.1: How often would you use the facility and for how long?

3.2.3 Collaborations

Just over half (52%) of businesses felt it was likely that they would contract collaborative research through the centre (Figure 3.9). The remaining 48%, however, indicated that they would be unlikely to collaborate with other companies. This contrasts sharply with an earlier results when 90% of the respondents indicated that they envisaged using the centre for activities around collaboration on research programmes.

The 12 businesses that indicated an interest in collaboration were then asked to estimate the likely value of a collaborative piece of work. Although one-quarter were not sure, half of the respondents estimated between £51k - £100k or £101k to £250k (25% and 25% respectively) (Figure 3.10).

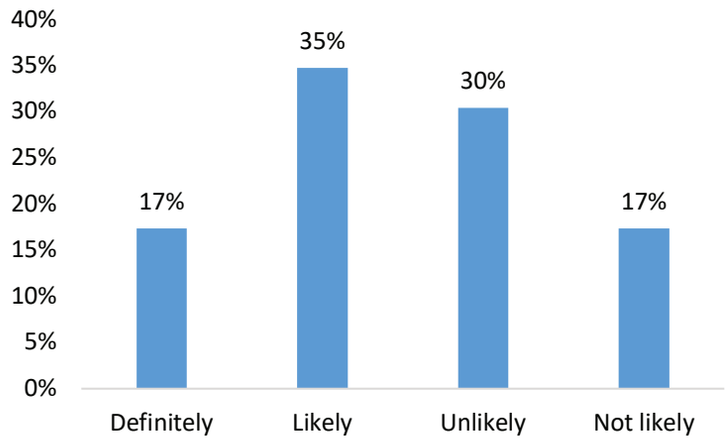


Figure 3.9: How likely is it that you would contract collaborative research through the NSC? N=23

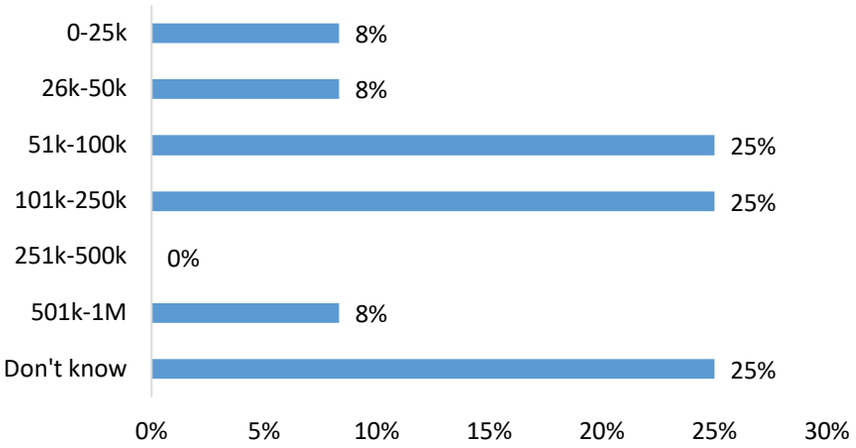


Figure 3.10: What would be the likely value of a collaborative piece of work? N=12

3.2.4 Additional Perspectives

Further perspectives and the overall message gained from additional comments were that the NSC would be beneficial for businesses as well as the wider economy and it would encourage a wider range of individuals to become involved in the sector. A sample of the responses is outlined below:

"I think the setting up of a National Spectrum Centre is the missing piece in the Welsh economic jigsaw…The new 5G network means Wales has a real opportunity to take the lead in this sector and the National Spectrum Centre will act as a stimulus for an exciting new area in the Welsh economy."

"…it will not only help drive a sector of the economy that is growing but also have a positive impact on the local economy. A top facility will attract cluster businesses and companies will use local hotels, bars and restaurants… There is a real shortage of skilled RF engineers in the UK at the moment and the establishment of a Spectrum Centre will help solve this problem."

"…It would help reverse the decline in the number of graduate and post graduate students entering the sector."

"The Spectrum engineering workforce is aging and there will be a substantial skills shortage in this area in the future."

3.3 Economic Impact Assessment

3.3.1 Business visitor usage of the NSC

The responses to the telephone survey were also used to estimate the economic impact arising from the usage of the NSC facility by employers. Importantly, as only one respondent reported plans to locate an office within the area, the assessment under this heading relates only to the temporary location of employees of organisations whilst they utilise the NSC.

To enable an assessment of the likely impact of the facility on this basis the model has focussed on the evidence contained within (Table 3.1) on the frequency and length of usage of the NSC by respondent employers. Responses to the two questions enable a calculation of an estimated annual usage of the NSC as a number of days. Estimates for each cell (based on the combination of answers provided) is presented in (Table 3.2) below.

It is notable within the table below that two responses are considered outliers. That is because the duration of engagement that the combination of those answers would give would lead to full time engagement with the NSC which is unlikely for a business not located or considering establishing an office in the area.

	How often would you use the facility?			
If you used the facility how long would you be there?	**Monthly**	**Quarterly**	**Twice a year**	**Once a year**
A couple of months	Outlier	160 days	80 days	40 days
A month	Outlier	80 days	40 days	20 days
A week or two	90 days	30 days	15 days	7.5 days
A day or two	18 days	6 days	3 days	1.5 days

Table 3.2: How often would you use the facility, and for how long? Estimated Days

The estimated number of days associated with the responses to each question have been multiplied by the number of respondents who cited that level of engagement with the NSC. Across all 22 eligible (non-local) respondent organisations, this equates to usage of the centre of around 557.5 days per annum. When this is divided by the number of eligible users it equates annually to 25 days of local presence to use the NSC per annum for each 'non-local' organisation (Table 3.3).

Table 3.3: Average annual usage amongst non-local organisations

	Day estimates multiplied no. of respondents			
	Monthly	**Quarterly**	**Twice a year**	**Once a year**
A couple of months	n/a	0	0	40
A month	n/a	0	80	0
A week or two	180	30	90	7.5
A day or two	0	12	15	3
Total days				**557.5**
Eligible frequency of respondents				**22**
Estimated average annual usage per employer (days)				**25**

Exploring the organisational location of respondents to the survey it is evident that those who did not describe themselves as local were either in the north east or south east of Wales or (for the majority) were located outside Wales. In all instances it would be reasonable to assume that multi-day engagement with the centre would likely involve overnight stays.

Evidence[26] shows that on average, domestic overnight visits for business related activities in Wales incurred an average spend per night of £85.40. On this basis, direct expenditure per annum associated with the usage of the centre per employer is estimated to be at least £2,135. This is a conservative estimate as it assumes that just one employee engages with the centre during that time. In a peripheral location such as west Wales it is reasonable to assume a relatively high multiplier effect for the local area, therefore, it would be reasonable to apply a multiplier of 1.5 to account for the indirect and induced impact arising from this spend. This equates to an average additional impact of £3,203 per employee of each non-local organisation that engages with the NSC.

The figure of £3,203 can then been used as a factor to estimate business visitor related expenditure within the local area. For example, this level of expenditure could be applied to the 22 non-local respondent organisations whose responses led to the identification of average usage levels of 25 days per year. Where applied to these respondent organisations it equates to additional business visitor expenditure of £70,466 per annum.

It is also likely that organisations will send more than one employee to the NSC and it is considered reasonable to assume that two employees per organisation would attend each visit. This would therefore equate to around £141,000 of additional expenditure per annum for those surveyed businesses.

Were we to extrapolate that figure to be representative of the eligible population for this research (46 employers), after factoring in a similar proportion for locally based employers (8.3% of all respondents) it equates to an estimated additional visitor related expenditure of £269,000 per annum.

This level of expenditure alone is expected to support three full time employees in the local area[27].

3.3.2 Collaboration Expenditure

Just over half of respondent businesses (52%; 12/23) were likely to contract collaborative research through the NSC. Respondent's estimates of the value of collaborative research varied widely and a quarter of these respondents felt unable to estimate the likely value of this research. The average value of collaborative research estimates should, therefore, be treated with caution due to the low power (frequency) of response.

Based on analysis of the value of collaborative research it is estimated that collaborative research contracts will, on average, be valued at £177,000 per organisation that described being likely to undertake research collaborations and £67,500 per organisation for all organisations engaged (regardless of their appetite for collaborative research).

Again (whilst applying necessary caution), the estimated value of contracted research per organisation can be extrapolated to reflect the eligible population for this research (46 organisations) and/or the number of organisations that the NSC anticipates engaging with per annum. When extrapolated to reflect the eligible population of this research it equates to collaborative research expenditure of £3.1 million.

The multiplier effect associated with the professional and scientific sector in Wales is estimated to be 1.37 (Type II)[28]. When this is applied to contractual research expenditure it equates to an estimated £4.25m after indirect and induced effects have been taken into account. Whilst it is noted that a timeframe associated with contractual research values was not included in the survey, if the research took place over a 12-month period it would support 25 posts in the scientific research and development sector[29].

3.3.3 Additional Areas of Research

This impact assessment could be regarded as limited since it has relied on speculative impacts and specifically on impacts associated with usage and collaborative research. As such, this assessment overlooks what could be regarded as far greater influences on economic impact arising from the NSC, namely the commercial gains of organisations that utilise the facility for their research.

It is recommended that research is conducted 18 months to 2 years following the launch of the NSC to revisit the impact estimates set out within this report and to explore the economic impact arising for organisations that have used the centre to conduct research.

3.4 Additional Impact

Additional elements of impact have been explored by using estimates of build costs and operational scale provided by Aberystwyth University. The emphasis of additional impact has been to the local economy rather than on the impact or benefit that the University may derive (through tuition fees for example). There is a danger of double counting if tuition fees were included in the calculations as they would be used to pay for staff salaries and the maintenance of the facility for example. The impact model has also avoided speculation on displacement and potential leakages but has included multiplier effects in the calculations of impact.

3.4.1 Temporary Construction related impact

There are a series of temporary construction related impacts associated with the planned build scheme for the National Spectrum Centre. The development of the NSC will be in three phases1 following the establishment of the headquarters by June 2020.

1. Phase 1 covers the use of existing facilities in their current form, that is without NSC adaptation. An example of this would be the use of QinetiQ

Aberporth and the Milford building on Gogerddan campus, Aberystwyth University, which is achievable within the next calendar year.

2. Phase 2 has two parts: instrumenting existing facilities, such as QinetiQ Aberporth, and the first tranche of new builds. The new builds are planned to be availble for use in three years time.

3. Phase 3 also has two parts: a second tranche of new build and to start establishing a major facility such as the 'covered Valley' facility, potentially very large and very expensive. Before work in earnest can start on its implementation the NSC must prove that it is a viable proposition, and large-scale funding needs to have been secured. Hence the time establishing this is five years plus.

The initial build costs of this scheme are estimated to be £10m and it is therefore of a scale that would take an anticipated 12-18 months to complete. When multiplier effects are applied to construction of this scale[30] this equates to £14.6m of expenditure impact. Expenditure of this nature over a 12 month period would support an estimated 98 temporary construction jobs (or 98 construction job years, equivalent to 9.8 permanent construction jobs based on 10 temporary construction jobs to one permanent job).

The second phase of the planned scheme is far larger in scale, incorporating, the following elements, alongside their preliminary estimated costs.

- Spectrum observatory (£5M)
- Covered Valley (£150M)
- Drone testing facility (£2M)
- Maritime test facility (£2M)
- High speed test facility (£2M)
- Road test facility (£2M)
- Rail test facility (£2M)

Collectively these schemes would equate to construction spend of approximately £165M. It is likely that construction on this scale would take at least 3 years to complete, however to overcome any inaccuracy in estimating construction timeframes it is best to equate the impact to construction job years. Based on current turnover to employee ratios (and avoiding the application of net present value assessment) yet factoring in multiplier effects, it is estimated that this level of construction spend will equate to supporting 1,621 construction job years. Economic impact guidance suggests that 10 construction job years equates to 1 permanent position, applying this equation to these figures suggests 162 construction jobs created if the construction scheme met the estimated costs.

It is clear that an investment on this scale will have a significant economic impact on Mid Wales. With the development of the NSC there will also be additional supplier purchase impacts on the economy in terms of goods and services. These will have additional positive demand effects on local services. The amount that will be spent on goods and services is currently unknown and will depend on whether goods and services purchased for the NSC come from the local area of Mid Wales or the rest of the UK? Further details of this expenditure will be established once the scope of the project has been realised.

3.4.2 Potential development funds and income generated impacts

Income for the development of the NSC facilities and infrastructure and the NSC training capability will be generated from funds and revenues from various sources. These include income from funding councils, funds from research programmes, government and industry funded research, match funding for competed research, financial support from Welsh Government, links with industries and income from student tuition fees. The commitment for the NSC is in line with other testbeds where there has £200 million has been investment in UK testbeds and trials to explore 5Gs contribution and impact, with packages receiving around £30 million. The Compound Semiconductor Catapult in South Wales is an £80M Cardiff University and Welsh Government initiative. Other examples of similar commitments exist in the manufacturing and biological sciences sectors

Potential funding sources[1] which will be available for the development of facilities and infrastructure at the NSC could amount to £26.25M (Table 2.1) and potential funding streams for research development of £95.5M (Table 3.4). Applying a multiplier effect to this figure gives an impact of £167.7M accounting for the indirect and induced impact arising from this spending.

Table 3.4: Potential NSC Funding streams for research and development

Potential Funding Source	Amount (per annum)	Purpose
NSC research programme		
Central Govt Grant (eg DCMS)	£50m	Fully-funded research programme run by the NSC
Third-party research projects		
Government funded research	£10m	Fully-funded research projects from various Departments, for example MoD (Dstl) which the NSC will run through its supplier-base.
Industry funded research	£500k	Fully-funded internal industrial research which the NSC will run through its supplier-base.
Competed research		
InnovateUK	£5m	Matched funded research competed for and won by NSC and members of its supply chain.
TechUK	£1m	
International funds	£20m	
Academic funding		
HEFCW funding		Research grants
Student Fees	£1.5m	Fees to cover the cost of NSC educational services.
Fees for use of NSC facilities and services		
Membership fees	£500k	See text below.
Third-party funded research	£2m	Fees for the use of NSC facilities as part of their research and development activities.
Cyber range	£5m	Use of the cyber range for pre-certification, training and resilience testing.
Total for the year	**£95.5m**	

3.4.3 Operational Impact

There are several other impacts associated with the operation of the National Spectrum Centre beyond those attributed to private sector businesses using the facility. Each of these is explored below.

3.4.3.1 Staffing

It is anticipated that between 50-100 staff will be employed by the NSC once it is fully operational. It is understood that the nature of roles employed at the centre will be wide-ranging, consequently ASHE[31] data has been used to identify average (median) salaries for the Professional, Scientific and Technical Activities industry sector, which in 2019, stood at £37,097 for a full time worker in the UK. Based on this average salary it is estimated that gross earnings across the staff employed would range from £1.85m to £3.7m per annum.

Staff Location	Ceredigion	Rest of Wales	Rest of UK
Spending in Ceredigion	50%	30%	15%
Spending in Rest of Wales	75%	75%	30%
Spending in Rest of UK	100%	100%	100%

Table 3.5. Staff spending

Staff employed by the NSC will have a direct impact on the local economy, by spending their salaries on goods and services in the area, including food, housing and consumables. The economic impact of staff salaries will depend on where the members of staff live. Previous research[32] found that 91% of staff employed at Aberystwyth University lived in Ceredigion whilst it was assumed that the remainder lived elsewhere within Wales. If the members of staff employed by the centre all live within the local Mid Wales area, then wages will have a direct impact on the local economy. The table (Table 3.5) extract our research illustrates that 75% of staff salary is spent in Wales, equivalent to £1.4m-£2.8m per annum.

Direct expenditure of this nature from the additional staff employed at the NSC will support an estimated 17-34 jobs per annum in other sectors such as retail and entertainment[33]. When multiplier effects are applied[34] a further 7-14 jobs are supported through the supply chain in the local area generated by expenditure of staff employed at the NSC.

An alternative way of quantifying this impact is by expressing it as gross value added with staff expenditure equating to between £0.7m and £1.4m per annum for Wales[35].

3.4.3.2 Teaching and learning impacts

The NSC plans to train and educate a number of undergraduate and graduate students, as well as graduates employed in companies within the UK workforce. There are currently 50 enterprises collaborating with learning providers in research and innovation activities. This training will be aimed at developing skills in higher level engineering, advanced manufacturing and new radio spectrum innovations through the Radio Spectrum Engineering Training programme. This will have an estimated value £2.4M[36].

It is anticipated that there will be approximately 100 students studying for an undergraduate degree per year (55 female, 45 male) and gaining a qualification or credits towards a qualification upon leaving. A further 25 participants will undertake a Master's degree per year (14 female, 11 male). Modules and specific areas of study are currently under discussion, but it is envisaged that they will include: Electronics and Photonics; Communication and Technology; High frequency sounding; Systems Engineering; Internet of Things; Marketing for Managers, amongst many others. These will combine a wide range of expertise from academics across a wide range of disciplines at Aberystwyth University. These would include the Physics department, Computer Science and the Business School. It is envisaged that some additional staff will be needed to help run these modules.

Student fees for UK undergraduate and master's students are currently £9,000 per year. The 125 students paying fees for the Radio Spectrum Engineering programmes have the potential to contribute £1,125,000 per year in income to the University and the NSC. Applying a multiplier effect to this figure £1,687,500 per annum would be generated from the direct and indirect impacts arising from student fees from the Radio Spectrum Engineering training programmes.

Plans are being developed to establish 5 PhDs per year, for example sponsored by The Defence Science and Technology Laboratory (DSTL) and QinetiQ, in collaboration with other industry sponsors. Other fully funded research programme run by the NSC will also be developed, for example supported by funding from the Department for Digital, Culture, Media & Sport (DCMS) DCMS tuition fees.

The cost for PhD studies in the UK is currently around £4,500 per year for UK and EU students and up to £18,000 for international students for the first three years. Income generated by 5 PhD students would amount to between £67.500 and £270,000 for the NSC over the lifetime of their PhD. The wide variation in income is a result of whether these students are UK, EU or international students. The income would flow into the future as new intakes would also be recruited each year.

As well as running the above, the NSC will also host networking events, seminars and external training events. Taken together these educational, training and research programmes, alongside the networking events, would drive growth across industries, by promoting the use of new and emerging technologies as well as enabling the exploitation of new and emerging opportunities in the application of the radio spectrum.

3.4.3.3 Operational impacts-students

NSC students will have an impact on local and wider economies. These impacts would include general student expenditure in their local economy and impacts of any part time work they undertook. It is anticipated that 125 students will be enrolled on courses at the NSC, made up of 100 undergraduates and 25 Master's students and in addition, 5 PhDs. Students living in a small town create a vibrant year-round economy, spending money on food, accommodation, retail, as well as other indirect expenditure. Taken together they would create further jobs in the local economy.

Aberystwyth University's estimated cost of living for students includes: accommodation, food, mobile network costs, books and equipment, clothing, travel, insurance, energy costs[37]. For a student based in halls of residents the cost is estimated to be at least £7,550 per annum. For those residing in private sector accommodation it is estimated at £8,160 per annum[38]. These figures are provided by the university and the rental rates are minimal costs. It is estimated that around 50% of students live in university residences, therefore it is reasonable to

estimate an average spending impact per student of £8,000 per annum. The entirety of this expenditure is estimated to be incurred in the Welsh economy[39]. This level of expenditure, across undergraduates and postgraduates equates to additional expenditure of £1m in the Welsh economy per annum, which, combined with multiplier effects, equates to £1.41m of direct and indirect expenditure. This level of expenditure will support an additional 17 jobs in the Welsh economy and is equivalent to an additional £0.5m GVA per annum.

Other indirect impacts, as a result of students in the area, include knowledge transfer and work placements. One of the main ways knowledge will be transferred from the research carried out in the NSC into industry, is by the employment of graduates on graduation or via work placements. Through knowledge transfer, students apply what they have learned, and thus enhance their company's future productivity. Work placements bring benefits to both students and the companies in which they work. For students it improves their employability while companies benefit from the application of new knowledge. Potential links between the students and the businesses using the NSC will potentially bring benefits to all the parties concerned and impact positively on the wider economy in the long term.

3.4.3.4 Operational impacts- friends/family/business visits

In addition to the direct benefits associated with the engagement of high tech businesses with the NSC further impacts will also be felt from "tourism" associated with visits from friends and family to the students on NSC programmes. Visits will have a positive effect on spending in the area and will further support jobs in the tourism and food and drinks sectors of Mid Wales.

Aberystwyth University has also estimated that there could be an additional 300-450 overnight stays from businesses per annum to events at the NSC. This estimate is derived from an anticipated 10 events held per year at the centre and based on the assumption that 15 delegates would attend each event and stay for between 2 and 3 nights once the NSC is operational. Evidence[40] shows that on average, domestic overnight visits for business related activities in Wales incurred an average spend per night of £85.40. These overnight stays therefore equate to an estimated additional £25,600-£38,400 of expenditure per annum.

It is also anticipated that one annual conference will be held per year similar to the original focus event with approximately 80-100 delegates in attendance, staying for on average between 2-3 nights. This would equate to an additional 200-250 overnight stays per annum or £17,100-£21,400 expenditure per annum.

Further visitor related expenditure will come from friends and family visiting students at the NSC. Evidence[41] again shows that on average every student received 0.8 visits from friends per annum which equates to 100 friends visiting the 125 students per annum. If each friend were to say between 2-3 days on average per year this would generate to between 200-300 overnight stays. Visiting friends and relatives are typically associated with lower rates of expenditure per night than business related expenditure and this is estimated to be £34.5 per night in Wales[42]. Additional visitor related expenditure to students at the NSC could generate between £6,900 and £10,350 per annum.

Combining the expenditure of visits associated with the operation of the NSC equates to annual expenditure of between £49,600 and £70,150 per annum. When multiplier effects are included an extra 1-1.5 jobs are supported within the local economy per annum.[43]

3.5 Summary of economic Impacts

The table(Table 3.6) below summarises the potential (largely temporary) impacts from the construction of the NSC alongside the operational impacts associated with expenditure of students and staff that work from the centre and visitors to students enrolled at the centre. It illustrates that the operation of the NSC could support between 42 and 66.5 jobs in the local area. It is important to note that this excludes costs and impacts associated with the maintenance of the centre.

Table 3.6: Summary of potential impacts from construction and operational impacts.

Impact	Employment (direct and indirect)	Expenditure (direct and indirect)	GVA (direct and indirect)
Construction Related Impacts			
Construction – Phase 1	9.8 permanent construction jobs	£14.6m	£5.5m
Construction – Phase 2	162 permanent construction jobs	£240.9m	£91.5m
Operational Impacts (per annum)			
Staff expenditure	24-48 jobs	£2m-£3.9m	£0.7m-£1.4m
Student expenditure	17 jobs	£1.4m	£0.5m
Visitor expenditure	1-1.5 jobs	£70k-£100k	£25-35k
Total operational expenditure related impacts	**42-66.5 jobs**	**£3.47m-£5.4m**	**£1.2-£1.9m**

3.6 Wider Economic Impacts and the Agglomeration effects

Wider economic impacts are difficult to estimate at this time, but they would include the impacts of developing spectral technology and its contribution to spectrum industry and the potential for the NSC in Mid Wales to create a globally important cluster or hot spot for spectral engineering. Applied research based at the NSC, would have to respond to spectrum based global challenges. These reactions would have an impact on wider global economy, as well as on the Welsh and UK economies. The evidence suggests that on average £1 of public R&D investment generates around £7 of net benefit to the UK. The NSC would play an important role in the contribution to international spectrum development; in particular by promoting spectrum efficiency and availability. This would place Mid Wales at the centre of the globally competitive spectrum industry. At this stage the impact of these developments cannot be predicted.

The availability of facilities at the NSC will help small businesses or SMEs to research and develop spectrum products. Working in a collaborative environment will encourage a number of start-up businesses in the area. The NSC has already established effective engagement with key stakeholders and as a result opportunities will exist for SMES to tap into links with government clients, guided and facilitated by QinetiQ. These SMEs will benefit directly from the economic contribution that radio spectrum activity is expected to contribute to the economy. This has been estimated to be worth £104 billion by 2025. The AIEC also plan to provide additional help by running a NSC Accelerator Programme for up to 12 start-up companies.

Knowledge transfer will also take place between the research activities of the NSC and industry in addition to the commercialisation of innovations. As indicated earlier there is an expectation that as a result of the NSC there will be an increase in the number of start-up and spin-off companies. The production of spectrum services and products will also be seen as a direct result of the NSC. Applying knowledge to real world problems and establishing links between academic staff and industry will encourage rapid the developments of products and innovative technology by SMEs. This in turn will have a positive economic impact on Mid Wales.

It is likely that there would also be a range of wider economic impacts associated with the operation of the NSC. To identify those impacts would require a fuller and far more detailed and comprehensive piece of research. One element of potentially significant and additional impact could arise from the agglomeration effects associated with the NSC at Aberystwyth and the plans for drone testing and research and development at Llanbedr in conjunction with the testing facilities at Aberporth. The three sites collectively provide significant potential for agglomeration effects, supply chain collaboration and potential clustering. The scale of the Llanbedr scheme is dependent on funding and planning, as is this scheme and therefore attempting to quantify this impact would be largely futile. The potential, however, to have a knowledge driven, research led cluster in what is otherwise a peripheral location in the UK economy is clear.

3.7 Summary

- Economic funding attracted to Mid Wales will have a positive economic impact on the local economy.
- Positive economic impacts will be felt in Mid Wales, as a result of high-income staff wages, capital investment in the NSC, the impacts from students, as well as the impacts from visitors and wider business engagement.
- All companies and research institutes generate a set of core economic impacts, including both direct and indirect economic, which in turn have positive multiplier effects in the local area.
- The development of the NSC will be phased and will require an investment of costs up to £175M, if all the various aspects are covered.
- Potential funding sources which will be available for the development of facilities and infrastructure, as well as funding streams for research development will lead to a potential substantial income (£111.8M) being generated by the NSC.
- It is estimated that as a direct consequence of establishing the NSC between 42 and 66.5 jobs would be created, while up to 172 temporary construction jobs would be created during the phased development of the centre.
- The Radio Spectrum Engineering Training programme provided by the NSC will have a positive impact on the future of the radio spectrum industry, developing skills in higher level engineering, advanced manufacturing and new radio spectrum innovations with an estimated value of £2.4M.
- Student impacts include knowledge transfer, enhancing future firm productivity, greater employability and higher earning potential, as well as developing a highly educated population, which will have longer term benefits to society.
- Businesses interviewed about their interest in the NSC, cited test and evaluation services and collaboration on research programmes; access to academic support and research laboratories; early product development and the generation of Intellectual Property as important to the majority of respondents.
- The most commonly required NSC facilities by interested respondents included an outdoor lab environment (88%), spectrum observatory (80%) and drone testing facilities (80%). Fewer than half required road test or rail test facilities (48% and 40% respectively), whilst one third (28%) perceived a need for secure office space within the NSC.
- Secure test facilities (away from members of the public) were cited as important by (43%) of respondents. Around 29% require real world testing of their products, 21% suggested remote access such as satellite or video conferencing facilities would be beneficial and help to offset the remoteness of the location.
- Just over half (52%) the businesses interviewed were likely to contract collaborative research through the centre, equating to a collaborative research expenditure of £3.1M.
- Wider economic impacts include developing spectral technology and its contribution to the innovative spectrum industry.
- The NSC could provide the potential to build on an already developing cluster of interrelated high tech industries in Mid Wales and thereby create a globally important hot spot for spectral engineering.

- This study is limited in its scope and as such, it overlooks what are likely to be far greater long run influences of economic impact arising from the NSC, namely the commercial gains to organisations that utilise the facility for their research[29].
- It is recommended that research is conducted 18 months to 2 years following the launch of the NSC to revisit the estimated impacts set out within this report and to explore further the economic impact arising from and for the organisations that have used the centre to conduct research.

4. Conclusion

The Radio Spectrum is a finite natural resource and an essential service. Demands for its availability have increased dramatically, due to the increase in the number of wireless devices and growing quantities of data transmitted over the internet. The UK Spectrum Strategy aims to increase the economic contribution of spectra to £104 billion by 2025 and there is huge potential for further developing spectrum technology. The National Spectrum Centre, in rural Mid Wales, would be well placed to develop spectrum technology in this rapidly expanding field.

The rural nature of Mid Wales, poor access to services and increasing reliance on online service provision mean that access to efficient broadband or internet connectivity is essential to the development of local businesses and the provision of public services. The area of Mid Wales has a low population density with an ageing population, with a significant number of the young working age population leaving the area, driven by low wages and poor access to mobile coverage. With so many residents living in rural locations and businesses working remotely, all requiring access to reliable broadband, the reliability of the internet is increasingly becoming an essential service. The current situation with Covid-19 has highlighted the importance of reliable internet connectivity, across all sectors, to keep people and businesses connected.

The National Spectrum Centre will be a one of a kind hub of radio spectrum expertise driving forward radio spectrum technologies. These will enhance productivity, and will provide a direct and indirect boost to the local, as well as the Welsh and UK economies. The NSC will place Mid Wales on the world stage, offering high income jobs and it will provide high level training for the workforce in the radio spectrum industry. Significantly it will offer a collaborative research environment embracing Government, Academia and Business that will increase knowledge transfer and expertise. It will provide access to spectrum development facilities to businesses and increase employment opportunities in the area. Wide interest in the concept of an NSC has already been established with backing from the Ceredigion Council, the Welsh Government, a letter of support from UK MoD, and interest from The Home Office. The NSC has also been prioritised by the Growing Mid Wales Partnership (Mid Wales Growth Deal) and other key funding bodies, owing to its potential for transformational impact on the area.

The NSC will own and have access to test and experiment facilities across Wales. The rural environment in Mid Wales is ideal for testing radio spectrum products and services, with facilities and skills provided by Aberystwyth University and by QinetiQ. The most commonly required NSC facilities cited by business included an outdoor lab environment (88%), spectrum observatory (80%) and drone testing facilities (80%). The need for secure test facilities (away from members of the public, security at the facility and compliance to government testing guidance) were also cited as very important by potential users. Opportunities for real world testing of products would also be beneficial. Businesses (21%) suggested that remote access such as satellite or video conferencing facilities would also benefit them and would help to offset the remoteness of the location. As video conferencing becomes more common place in a post Covid world, this may make the NSC's location less of an issue for users.

Businesses and industry are likely to contract collaborative research through the centre, equating to a collaborative research expenditure of £3.1M. It is estimated that as a direct consequence of establishing the NSC between 42 and 66.5 jobs

would be created, while up to 172 temporary construction jobs would be created during the phased development of the centre. The Radio Spectrum Engineering Training programme provided by the NSC will have a positive impact on the future of the radio spectrum industry, developing skills in higher level engineering, advanced manufacturing and new radio spectrum innovations with an estimated value of £2.4M.

Developments in spectrum engineering and innovation and the start-up companies forming as a result of the NSC will create new opportunities for employment and training for the Mid Wales workforce and population. In particular the NSC will provide opportunities for the younger working aged population seeking to remain in the area. The result of both direct and indirect impacts will make an important contribution to the resilience of the local economy by generating high value employment. It will also support the local supply chain and stimulate a vibrant local economy, enhancing a year-round tourism industry, whilst securing local services. Wider economic impacts associated with learning include reduced risk of unemployment, better physical health, greater civic engagement and widening participation. Other impacts include the development of spectral technology and its contribution to innovative spectrum industry and the potential for the NSC in Mid Wales to create a globally important hot spot for spectral engineering.

This research is limited in its scope reliant upon speculative impact and specifically on impact associated with usage and collaborative research. It is recommended that research is conducted 18 months to 2 years following the launch of the NSC to revisit the impact estimates set out within the scope of this report and to explore further the economic impact arising for organisations who have used the centre to conduct research.

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6. Appendix

Facility	Nature of the facility	Location
NSC owned		
NSC HQ	Offices.	Milford Building, Aberystwyth
NSC education facility	Lecture theatres and study facilities.	Milford Building, Aberystwyth
In-door lab environment	Laboratories to support the academic programme.	Milford Building, Aberystwyth
Out-door lab environment	Instrumented area for large scale testing and experimentation can take place.	Aberystwyth
In-door test range	A large building supporting testing and experimentation at scale.	Location not identified
RF Facilities	A number of fixed and mobile instrumented facilities for ad hoc testing and experimentation.	Locations not identified
Cyber Range	A building designed as a reference centre to test and certify equipment.	Location not identified
Spectrum observatory	A building acting as a repository for all NSC research output and relevant data sets and computer models available for use on NSC supported activities.	Location not identified
'Covered Valley'	A valley enclosed in a similar way to the Eden Project. The internal space will be a controlled RF ecosystem that can be adapted to represent different real-world environments. When not being used by the NSC the space would be made available for commercial events such as concerts.	Location not identified
Third-party owned with NSC instrumentation		
Drone test facility	Instrumented range for testing drone-based systems	QinetiQ Aberporth
Maritime test facility	Instrumented range for testing systems in a maritime environment.	QinetiQ Aberporth
Radar Test Facility	A range to accurately track vehicles (particularly air vehicle).	QinetiQ Aberporth
High-speed test facility	Instrumented range where systems can be tested at very high velocities (Mach 1 +)	QinetiQ APendine
Road test facility	An instrumented road test track for testing road and automated vehicles.	Location not identified
Rail test facility	An instrumented rail test track for testing rail and automated vehicles.	Location not identified
Third-party owned		
Demonstration and conference facilities	Large public area for RF demonstrations.	E.g.: Welsh Show Ground
Demonstration and conference facilities	Large public arena	E.g. Cardiff Conference Centre

Table 6.1: National Spectrum Centre facilities

QinetiQ Activity	Cost/Revenue Model	Costs/revenue assumptions	Cost/ Revenue	Profit
QinetiQ as a Trusted Partner				
Board Member	Named individual - *BD funding*	10 man-days per annum		
Trusted partner support to NSC Engine Room	Man-power to support Engine Room activities - *Full commercial manpower rates*	2 FTEs		
Trusted partner support to the R&D programme	Man-power to support/run the research framework - *Full commercial manpower rates*	2 FTEs		
Trusted partner support in the provision of QinetiQ owned or run facilities and services	Man-power, facilities and equipment to support/run experiments conducted or supported by the NSC. - *Full commercial manpower and service rates*	5% of research programme funding		
QinetiQ as a Research Provider				
QinetiQ as a research provider undertaking competed NSC R&D programme projects.	Man-power to run the research project. - *Full commercial manpower rates agreed with the funding source.*	Revenue is due to originating project, nothing accrues to QinetiQ through NSC. However QinetiQ may not have won the project without the NSC as part of the offering.		
QinetiQ as a third-party researcher who wishes to use NSC facilities are part of their project.	Man-power to run the research project. - *Full commercial manpower rates agreed with the funding source.*	Revenue is due to originating project, nothing accrues to QinetiQ through NSC. However QinetiQ may not have won the project without the NSC as part of the offering.		
		Total		
			Profit percentage	

Table 6.2: QinetiQ Activity

Facility	Development Costs
NSC Owned	
NSC HQ	
NSC education facility	
In-door lab environment	
Out-door lab environment	
In-door test range	£10m
RF Facilities	
Cyber Range	
Spectrum observatory	£5m
'Covered Valley'	£150m
Third-party owned with NSC instrumentation	
Drone test facility	£2m
Maritime test facility	£2m
Radar Test Facility	
High-speed test facility	£2m
Road test facility	£2m
Rail test facility	£2m
Third-party owned	
Demonstration and conference facilities	N/A
Demonstration and conference facilities	N/A
	£175m

Table 6.3: NSC Current known development costs

All of these funding sources as currently being pursued, but it is too early to identify specific facilities they will fund.

A high-level programme for the development of the NSC is shown below. The NSC is a large, long-term project whose full potential will be realised in five to twn years time. Due to its scale and the desire to start operating as soon as possible a phased approach has been adopted.

There will be three phases of development following the establishment of the Milford building in June 2020:

1. Phase 1 covers the use of existing facilities in their current form, that is without NSC adaptation. An example of this would be the use of QinetiQ Aberporth. This is 'low-hanging fruit' with no good reasons why this should not be achievable next calendar year.

2. Phase 2 has two parts: instrumenting exising facilities, such as QinetiQ Aberporth, and the first tranche of new builds. The new builds are planned to be availble for use in three years time, hopefully enough time to secure funding and do building. Which facilities will be included in Tranche 1 has yet to be determined.

3. Phase 2 also has two parts: a second tranche of new build and the start establishing the 'covered Valley' facility. Thisis potential very large and very expensive. Before work in earnest can start on its implementation the NSC must prove that it is a viable proposition, and large-scale funding needs to have been secured. Hence the time establishig this is five years plus.

Survey Tool used by Wavehill: National Spectrum Centre Potential Users

We understand you attended an event associated with the development of a National Spectrum Centre (NSC).

The Mission of the NSC is to: "Future proof spectrum solutions" with a Vision to "Create an ecosystem embracing Government, Industry and Academia accelerating spectrum innovations and drive sustainable growth".

To help us further understand the extent of business interest in the centre we would be very grateful if you could spend five minutes answering a few questions to inform the development of the project?

Q1. Are you happy to continue with the questionnaire? *Please note you can withdraw your consent at any time during the questionnaire*

- Yes
- No

Brief on the NSC:

As a national capability the NSC will be the UK centre of excellence for spectrum research. The NSC aims to help organisations research, develop and test spectrum-dependent systems more quickly, thoroughly and at lower cost than ever before.

The centre will provide easy access to large-scale instrumented spectrum range facilities and user environments, which will allow the research and testing of services and devices in realistic environments with minimum infrastructure set-up. The NSC will build relationships with government spectrum organisations, including Ofcom, and ensure that all licensing requirements are addressed.

Q2. When the NSC is fully operational how likely do you feel it would be that your company would use the centre?

Q2a. Please specify

Q3. For which of the following activities would you

envisage using the NSC?

- Access to Academic support and research laboratories
- Test and Evaluation Services (across all market sectors)
- Training and Teaching
- Collaboration on research programs
- Generation of IP
- Early product development
- Spectrum Voice for the UK

Q4. If other, please specify:

Q5. To what extent would cost be a factor in guiding your decision as to whether you would use the facility?

Q6. Why would you prefer not to use the centre? Is there anything that the NSC could do that would change your mind?

Q7. Would you be interested in a membership scheme with fees determining the level of access to facilities and services?

(Ranging from a full membership with full access to events, research programme and facilities to an associate membership with access to facilities for own use.)

Q8. We are developing a high-level training package in radio spectrum engineering for businesses which we hope will be subsidised through European funding. Would you welcome details of this training package?

- Yes
- No

Q9. One of the strengths of this region is having access to a range of facilities under the NSC umbrella. Would you require access to one or more of the following?

	Yes	No
NSC HQ		
NSC education/training facility		
In-door lab environment		
Out-door lab environment		
In-door test range		
RF Facilities		
Cyber Range		
Spectrum observatory		
'Covered Valley'		
Drone test facility		
Maritime test facility		
Radar Test Facility		
High-speed test facility		
Road test facility		
Rail test facility		
Office space		
Demonstration and conference facilities		

Q10. Are there any other specific facilities that you would you benefit from or prefer?

Estimated scale of usage

As part of the development of the NSC hub (the main site) we will have offices available for industry and others to have a base at the centre and we have aim to have larger facilities available nearby in the near future

Q11. When the NSC is operational, how likely is it that you/your organisation would set up a local presence (in either the available offices or other local offices for example) in the area?

- Very likely
- Likely
- Unlikely
- Very Unlikely
- We are already based in the local area
- We'd be happy to travel for occasional use
- Don't know

Q12. Briefly what would your base/offices/facility be used for?

Q13. Approximately how many (FTE) from your organisation would you anticipate working in the office/facility?

Q14. Could you provide a rough estimate of how many days per year, on average you or your staff might use the centre

(please multiply the number of staff that might use the centre by the number of days you would anticipate being used)

- None
- 0-5
- 6-10
- 11-24
- 25-49
- 50-249
- 250-499
- Don't know

Q15. For approximately what proportion of these staff visits would you anticipate involving an overnight stay in the area?

- None
- 1-20%
- 21-50%
- 51-80%
- 81-100%
- Don't know

Q16. For the above facility, how often would you use it?

- Once a year
- Twice a year
- Quarterly
- Monthly
- Weekly

Q17. Typically, if you used the facility how long would you be there?

- A day or two
- A week or two
- A month
- A couple of months

Q18. How likely is it that you would contract collaborative research through the NSC?

- Definitely
- Likely
- Unlikely
- Not likely
- Other

Q18a. If other, please specify:

Q19. What would be the likely value of a collaborative piece of work?

- 0-25k
- 26k-50k
- 51k-100k
- 101k-250k
- 251k-500k
- 501k-1M
- >£1m
- Don’t know
- Q20. Is there anything you would like to add?

Thank you for taking the time to complete this survey.